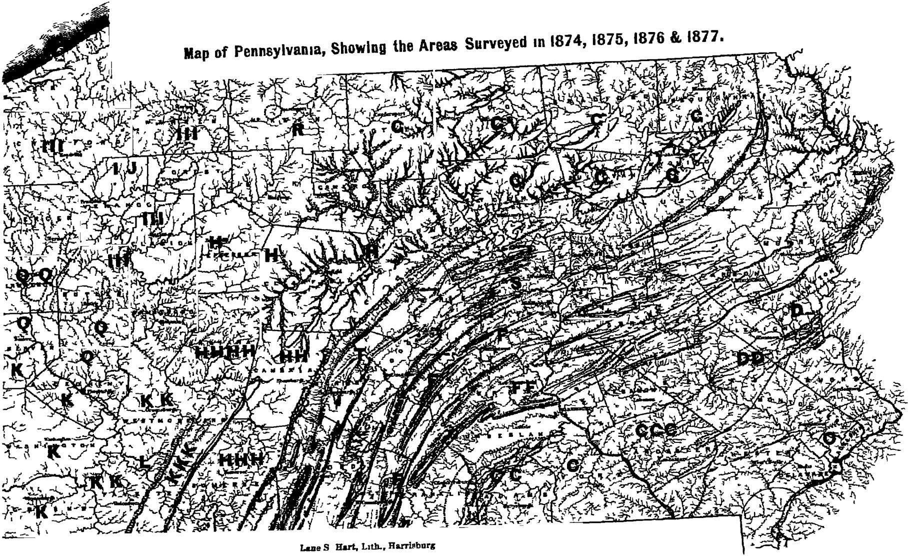
Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876 & 1877.



Lane S Hart, Lith., Harrisburg

GEOLOGICAL SURVEY OF PENNSYLVANIA:
1875.

REPORT OF PROGRESS

IN THE

BEAVER RIVER DISTRICT

OF THE

BITUMINOUS COAL-FIELDS

OF

WESTERN PENNSYLVANIA,

BY

I. C. WHITE.

ILLUSTRATED
WITH THREE GEOLOGICAL MAPS OF
PARTS OF BEAVER, BUTLER AND ALLEGHENY COUNTIES,
AND
21 PLATES OF VERTICAL SECTIONS.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY
1878.

[illegible]

Entered, for the Commonwealth of Pennsylvania, in the year 1877, according
to acts of Congress,
By JOHN B. PEARSE,
Secretary of the Board of Commissioners of Geological Survey,
In the office of the Librarian of Congress, at
WASHINGTON, D. C.

Stereotyped and printed by
LANE S. HART, State Printer,
Harrisburg, Pa.

BOARD OF COMMISSIONERS.

His Excellency, JOHN F. HARTRANFT, *Governor*,
and *ex-officio* President of the Board, Harrisburg.

Ario Pardee,	Hazleton.
William A. Ingham,	Philadelphia
Henry S. Eckert,	Reading.
Henry McCormick,	Harrisburg.
James Macfarlane,	Towanda.
John B. Pearse,	Philadelphia.
Robert V. Wilson, M. D.,	Clearfield.
Hon. Daniel J. Morrell,	Johnstown.
Henry W. Oliver,	Pittsburg.
Samuel Q. Brown,	Pleasantville.

SECRETARY OF THE BOARD.

John B. Pearse,	Philadelphia.

STATE GEOLOGIST.

Peter Lesley,	Philadelphia.

NOV - 5 '82

THE HUNT LIBRARY
CARNEGIE INSTITUTE OF TECHNOLOGY

ASSISTANT GEOLOGISTS.

PERSIFOR FRAZER, Jr.—Geologist in charge of the Survey of York, Adams, and Lancaster.

A. E. LEHMAN—Topographical Assistant, surveying the South Mountains.

FREDERICK PRIME, Jr.—Geologist in charge of the Survey of Lehigh, Northampton, Berks, and Lebanon.

A. P. BERLIN—Topographical Assistant, surveying the Limestone Valley and Reading Mountains.

JOHN H. DEWEES—Geologist in charge of the Survey of the Fossil Ore belts of the Juniata country.

FRANKLIN PLATT—Geologist in charge of the Survey of Clearfield, Jefferson, Cambria, Somerset, Armstrong, Blair, &c., &c.

W. G. PLATT—Geological Assistant in Cambria, Somerset, and Indiana.

R. H. SANDERS—Topographical Assistant in Blair, Somerset, Cumberland, &c.

J. J. STEVENSON—Geologist in charge of the Survey of Greene, Washington, Fayette, and Westmoreland.

I. C. WHITE—Geologist in charge of the Survey of Beaver, Lawrence, Mercer, &c.

J. F. CARLL—Geologist in charge of the Survey of the Oil Regions.

H. M. CHANCE—Geological Assistant for the Survey of the Water Gaps, and in Butler, Beaver, Mercer, Warren, &c.

C. A. ASHBURNER—Geological Assistant in Mifflin and Blair, and in charge of the Survey of McKean, Elk, and Forest.

C. E. BILLIN—Geological Assistant in Mifflin and Blair, and in charge of the Survey of the Seven Mountains, &c.

ANDREW SHERWOOD—Geologist in charge of the Survey of Bradford, Tioga, Potter, Lycoming, Sullivan, and Wyoming.

F. A. GENTH—Chemist and Mineralogist at Philadelphia.

A. S. McCREATH—Chemist, in charge of the Laboratory of the Survey, 228 Market street, Harrisburg.

C. E. HALL—Fossil Zoölogist, in charge of the Museum.

LEO LESQUEREUX—Fossil Botanist, Columbus, Ohio.

E. B. HARDEN—In charge of Illustrations for the Reports, 1008 Clinton street, Philadelphia.

CHARLES ALLEN—In charge of the Collection of Records of Railroad and other Levels, Harrisburg.

F. W. FORMAN—Clerk in charge of the Distribution of Reports from the rooms of the Board, 228 Market street, Harrisburg.

TABLE OF CONTENTS.

Letter from Professor I. C. White, ... iv
Preface by J. P. Lesley, ... ix
Description of a fossil fungus in the Darlington Shales, by Leo Lesquereux, ... xlvii

PART I.—GENERAL GEOLOGY OF THE DISTRICT.

CHAPTER I. Topography and soil, ... 1
CHAPTER II. Drift; terraces; buried river channels, 9
CHAPTER III. Anticlinals, ... 19
CHAPTER IV. Upper Productive Coal Series, . . 21
CHAPTER V. The Barren Measures, ... 23
CHAPTER VI. Lower Productive Coal Series. . . 39
CHAPTER VII. The Beaver River Group, (No. XII,) 65

PART II.—DETAILED GEOLOGY BY TOWNSHIPS.

CHAPTER VIII. Butler County, ... 73
1. Cranberry township, ... 73
2. Adams township, ... 75
3. Middlesex township, ... 78
4. Clinton township, ... 82
5 Buffalo township, ... 87
6. Winfield township, ... 91
7. Jefferson township, ... 97
8 Penn township, ... 100
9. Forward township, ... 104
10. Jackson township, ... 112
11. Lancaster township, ... 118
12 Connoquenessing township, ... 123
13 Butler township, ... 127
14. Summit township, ... 132
15. Clearfield township, ... 136

CHAPTER IX. Allegheny County, ... 141
16. Fawn township, ... 141
17. East Deer township, ... 146
18. West Deer township, ... 149
19. Indiana township, ... 152
20. Shaler township, ... 155
21. Hampton township, ... 158
22. Richland township, ... 162
23. Reserve and McClure townships, ... 163
24. Ross township, ... 166
25. McCandless township, ... 167
26. Pine township, ... 170
27. Marshall township, ... 171
28. Franklin township, ... 172
29. Ohio township, ... 174
30. Sewickley township, ... 177
CHAPTER X Beaver County, ... 179
31. Economy township, ... 179
32. New Sewickley township, ... 185
33. Rochester, ... 190
34. Pulaski township, ... 193
35. North Sewickley township, ... 203
36. Marion township, ... 214
37. Franklin township, ... 216
38. Big Beaver township, ... 222
39. Darlington township, ... 230
40. South Beaver township, ... 338
41. Chippewa township, ... 243
42. Patterson township, ... 247
43. Brighton township, ... 251
44. Industry township, ... 259
45. Ohio township, ... 262
List of Plates, and arrangement of sections, . .
List of Sections, as they occur in the text, . . .
Indexes, geographical, geological, and personal, .

MORGANTOWN, WEST VIRGINIA, *May 25, 1877.*

Professor J. P. LESLEY, *State Geologist:*

DEAR SIR: I have the honor to submit the following detailed report of my work during the season of 1876, covering portions of the counties of Beaver, Butler, and Allegheny, in the State of Pennsylvania.

During the first part of the season, I was engaged in making examinations along the Pennsylvania and Ohio State Line, from Smith's Ferry, on the Ohio river, north to Jamestown, on the north line of Mercer county, for the purpose of connecting and harmonizing the lately published carboniferous geology of Eastern Ohio, with the results of our surveys in Pennsylvania. In this work I think I have been entirely successful; but, at your suggestion, I postpone my report of it, in order to include it in my report for 1877 on the geology of Lawrence county.

I have been placed under many obligations, and take this opportunity to express my thanks for many favors received on behalf of the Survey, from Mr. I. F. Mansfield of Cannelton; from Judge Chamberlin and Mr. Mendenhall of New Brighton; from Mr. W. C. Bell of Sharon; from Mr. J. A. Herron of Allegheny; from Mr. J. W Ramsey of Beaver Falls, and others

Very respectfully,
Your obedient servant,
I. C. WHITE.

PREFACE

TO REPORT OF PROGRESS Q.

§ 1. In presenting this Volume of the Reports of the Progress of the Second Geological Survey of Pennsylvania to the Honorable Board of Commissioners of the Survey, for their approval and publication, I desire to invite their attention to the thoroughness with which its author, Professor I. C. White, has accomplished the task assigned to him as Assistant Geologist, in charge of the survey of the district lying north of the Ohio River and between Pittsburgh and the Ohio State Line.

The present report describes the geology of parts of three counties, Southern Butler, Northern Allegheny, and Northern Beaver.

Southern Beaver was described by Mr. White, in Prof. Stevenson's Report K, on Greene and Washington. See pages 335 to 349.

Southern Alleghany was described by Prof. Stevenson in Report K. See pages 296 to 349.

Eastern Alleghany was described by Prof. Stevenson in Report KK, on Westmoreland and Fayette. See pages 373 to 391.

Northern Butler has not yet been surveyed in detail, and will probably be described in connection with Armstrong county.

By referring to any map of the State, it will be seen that the northern county line of Beaver and the northern county line of Indiana are nearly on the same parallel of latitude; and that if they were prolonged so as to meet on the Alleghany river they would divide Butler and Armstrong counties each into two halves, a northern and a southern.

The plan was for Mr. White to cover all the country south of this line and west of the river, and for Mr. W. G. Platt to cover all the country south of this line east of the river But the field season was too short for this to be accomplished without slighting the work. Otherwise one half of southern Armstrong would be found described in this volume. The other half of southern Armstrong would then appear with Mr. Platt's forthcoming Report on Indiana county.

§ 2. Three colored geological maps accompany this report. I regret, more than I can express, the imperfections of these maps. They neither fit on to each other, nor correspond to any common standard map. In fact there is no such standard map in existence. There are County Maps, some of them very old, out of print and impossible to obtain except by loan from their owners; and there are others of later date; but none of them, old or new, are of any scientific value. There are also County Atlases, made up of township maps none of which can be made to fit together at their edges; and small county maps which are constructed and executed in so faulty a manner that the geologist and the engineer who attempt to use them are thrown into despair.

With these imperfect guides the Geologists of the Survey have been obliged to content themselves and do the best they could, laying in the outcrops of the principal coal beds and coloring the areas of the different groups of coal measures in reference to the streams. and roads, not one of which was properly located Nor will this scandal to our geology be removed until the Legislature organizes a scientific Topographical Survey of the State.

The United States Coast Survey has indeed begun a regular triangulation of the State, and promises to provide us with at least one absolutely sure position in every township of every county. But its means are so limited that this great work moves on very slowly and, unless State appropriations are made to hasten it, may occupy twenty or thirty years

Even after the Coast Survey has determined astronomically and by triangulation these several thousand fixed points, court-houses, main cross roads, &c., &c., we will only be at the threshold of our desires and necessities. From these determined points each township will have to be surveyed by itself, and then from such township surveys correct county maps may be constructed.

It is evident that the Geological Survey cannot wait for all this to be done. It must therefore use the almost worthless maps—county maps and township maps—which exist, rudely run as their lines have been by irresponsible men, on cheap money contracts, rapidly and carelessly plotted afterwards, and finally forced together recklessly and without judgment, so as to come within county lines which are themselves utterly false and often times half a mile away from their true places. Even the northern line of the State itself is found this year to be wrongly located at every point, so far as the new survey of it by the united commissioners of New York and Pennsylvania has advanced its stations.

To add to the confusion, the township and county maps thus falsely drawn have been still further falsified by a fresh set of errors inevitably connected with publication.

The application of photography to the first placing of a map upon the stone is a very recent invention, and even where it has been used the lines have not been strictly followed in all cases by the lithographer.

To illustrate what I have just said I invite attention to the locality of Unionville, in New Sewickley township, Beaver County. In Mr. White's geological map of the county Brush Creek will be seen exposing the lower coal beds, and flowing north into the Connoquenessing. It heads in Alleghany Co., cuts across the Butler Co. corner, and so passes on to Unionville.

Now, if any one will take the pains to look at the Beaver County map and at the N. Sewickley Township map in the

Centennial Atlas of Beaver County, he will be surprised to find high land at Unionville, from which a small Brush Creek flows the right way, northward into the Connoquenessing, and another Brush "Fork," starting south of Unionville and flowing the wrong way, southeastward, into Butler County.

Mr. White's study of the geology obliged and enabled him to correct this gross blunder of the Atlas. But in a thousand other cases of minor importance he was, of course, obliged to endure what he could not cure, and fit his outcrops to the streams.

It must be distinctly understood, therefore, that neither the author of this report nor the Geological Survey of Pennsylvania is responsible for the unreliable maps which are offered as illustrations. It must be distinctly understood that they are merely used to illustrate the geology; to serve as pictures to the reader's eye; to assist him to comprehend the superposition of the formations, the approximate lines of outcrop and size of areas of the different principal coal beds; and to show the amount of erosion which the Coal Measures of Western Pennsylvania have suffered during the ages elapsing since the rise of the continent out of the sea at the surface of which each coal bed grew.

§ 3. Twenty-one plates, containing about 225 vertical sections, will be found at the end of this volume.

One class, drawn to a scale of 100′: 1″, represent the order of beds and interval rocks at various localities; and these are grouped upon the plates so as to allow of convenient comparison. The general parallelism is evident. The local variations from a strict or theoretical parallelism are equally evident.

The other class, drawn to a scale of 10′ :1″, are intended to show the characteristic features of each coal or limestone bed, and the changes which these features undergo from place to place. They also are grouped for comparison: all the sections of the Darlington Coal bed together; all the sections of the Ferriferous Limestone together, &c.

§ 4. In Chapters IV, V, VI of his Report Prof. White has given a generalized description of each well-marked bed of coal, sandstone, shale, limestone, underclay, and iron-stone in the whole column of Coal Measures occurring in his district, from the Pittsburg Coal Bed *in descending sequence* downwards to and beneath the Millstone Grit, or Seral (Pottsville) Conglomerate; and 24 typical vertical sections accompany the text.

This *descending order* is observed in all the descriptions of local sections throughout the Report, as in all other published Reports of Progress of the Survey.

§ 5. In consulting the Index to this volume, the reader will find it divided into several indexes, the second one of which is a Geological Index of references to every place in the report where mention is made of any important bed. This Index is arranged in *descending order;* first, references to the Pittsburgh Sandstone, Coal, Limestone, &c., at the top of the column; then the Morgantown sandstone; Elk Lick or Berlin group, &c ; ending with the inter-conglomerate and sub-conglomerate beds.

The beginning of this index therefore corresponds with Chapter IV, the middle of it with Chapter V, and the latter part of it with Chapter VI.

It is needless to say that this will greatly facilitate the use and understanding of the report.

§ 6. A word is necessary about the nomenclature employed in this volume.

Professor White has of course used the old names for the beds of the Lower Productive Coal Measures, established by the First Geological Survey in 1837, viz: Upper and Lower Freeport, Kittanning, Clarion, and Brookville Coals, Mahoning and Freeport Sandstones, and Freeport and Ferriferous Limestones. But he explains the necessity for introducing three new names into this (Alleghany Valley) Series, viz: that of the Darlington Coal Bed; that of the Butler Limestone; and that of the Butler Sandstone; in as much as these very prominent members of the series in his district and along the Ohio River are of insignificant size, or otherwise obscure, if not entirely wanting along the

Alleghany River, and were therefore unfortunately overlooked and left unnamed in 1837.

He finds it proper to give to the upper member of the Mahoning Sandstone of the Old Survey, which is very massive in his district, a special name to distinguish it from the lower member He therefore speaks of the upper rock as Buffalo Sandstone, and of the lower rock as Mahoning Sandstone.

He finds between these massive and often pebbly sandrocks a coal bed, and a limestone bed, which he names the Brush Creek Coal, and the Brush Creek Limestone. These are not, properly speaking, local beds; for they have been seen in far distant localities. The coal bed, at least, thus locked up between the two members of the Mahoning Sandstone can be recognized as far east as Broad Top Mountain, in Huntingdon; and it seems to be represented in Cambria County by Mr. Platt's Gallitzin coal bed.

The unexpected discovery by Messrs. F. and W G Platt in the Barren Measures of Somerset County of a number of locally workable coal beds and limestones, which received from those gentlemen the special names of Elk Lick Coal, Elk Lick Limestone, Berlin Coal, Berlin Limestone, Platt Coal, Price Coal, Coleman Coal, and Coleman Limestone, Philson (Rose) Coal, and Philson Limestone—(See Report of Progress, HHH, page 286)—has been in a good degree verified and repeated by Mr. White in his district.

The Elk Lick Coal and Limestone are plainly marked.

The Berlin Coal is apparently wanting.

The Platt Coal, under the Crinoidal Limestone, seems to be represented by No. 13 of Mr. White's general Section, (see page 31,) but he gives it no special name.

The Price Coal is, perhaps, Mr. White's Bakertown Coal.

The Coleman Coal and Coleman Limestone correspond perhaps to his Pine Creek Coal and Pine Creek Limestone.

The Philson Coal seems to be absent; but its Limestone is represented by the Brush Creek Limestone.

I have already said that the Gallitzin Coal of Mr. Platt is named by Mr. White the Brush Creek Coal.

Besides these, Mr. White reports a local Gourd Head Run Limestone.

For the present we must endure this synonomy; but we may expect the forthcoming Report of Indiana County by Mr. W. G. Platt, to settle questions of identity, or co-extensiveness, like these relating to the Barren Measure beds. Enough, however, is already known to make it certain that the so-called Barren Measures, occupying an interval of about 600 feet between the Pittsburgh Coal Bed above and the Freeport Group below, have been hitherto misunderstood; that many, perhaps all of the coal and limestone beds which occur in them are deposits as wide spread and as recognizable as any of the more important *workable* beds of the Upper Productive Coal Series above them,* or of the Lower Productive Coal Series under them,† and that they will all receive names before the close of the Survey.

As to the beds of the Lower Productive, or Allegheny River Series, Mr. White is not responsible for the insertion into this report of the following names as synonymes: Upper and Lower Freeport Limestones, Upper and Lower Kittanning Coals, Upper and Lower Freeport Sandstones, Kittanning Sandstone, and Upper and Lower Homewood Sandstones.

My reasons for adding these synonymes, in a sufficient number of instances to familiarize the reader with them, were two-fold: 1. To simplify our nomenclature of the coal measures; and 2. To prevent too harsh a contrast between this and other Reports of Progress. A few words will suffice for explanation.

There are two well-marked coal beds at Freeport, which were named in 1837 Upper and Lower Freeport Coals. The limestone between them, and the sandstone under them, were at that time also named the Freeport Limestone and the Freeport Sandstone.

But Mr. White has found, near Butler, a massive sandstone between them, which he calls the Butler Sandstone;

---

* The Monongahela River System.

† The Alleghany River System.

and a massive limestone under them, which he calls the Butler Limestone.

Now, no good reason can be assigned against adopting the following simple series of names for this whole group, viz:

Freeport Group:
- Upper Freeport Coal.
- (Upper) Freeport Limestone.
- Upper Freeport (Butler) Sandstone.
- Lower Freeport Coal.
- Lower Freeport (Butler) Limestone.
- (Lower) Freeport Sandstone.

Further up the Alleghany River, at Kittanning, there are also two coal beds, only one of which, however, received the special name of Kittanning Coal in 1837; because the other was of insignificant size, and was not known to be persistent throughout the country.

But Mr. White has proved it not only to be persistent but to increase in importance westward, until it culminates in magnitude as the great Darlington Cannel coal bed in Beaver County.

This bed Mr. Franklin Platt, in 1874, traced throughout Jefferson and Clearfield Counties; and finding it a large and workable bed, and so often confounded with the bed next above it, he named it the *Lower* Freeport coal; assigning to the *old* Lower Freeport bed a new name, viz: the *Middle* Freeport. But continuing, in the course of his survey, to trace this bed eastward and southward into Cambria County, he was led to suspect the propriety of his new classification; and finally in his survey of Somerset County he became convinced that to speak of three Freeport beds was a mistake.

In all his Reports of Progress, however, H, HH, and HHH, the three beds are generally thus named:

Upper Freeport, E.
Middle Freeport, D′.
Lower Freeport, D.
Kittanning, C.

A special chapter is added at the end of the Somerset County Report to make the state of the case clear.

In the Report on Indiana County Mr. W G. Platt will return to the old nomenclature, and separate the two coal beds of the Freeport group from the two coal beds of the Kittanning group, thus:

Kittanning group {
Upper Kittanning (Darlington) Coal, C′.
Upper Kittanning Sandstone.
(Lower) Kittanning Coal, C.
Lower Kittanning Sandstone.

The final construction of the Clarion group cannot be adjusted until the second survey of northern Armstrong and Butler Counties, of Clarion County and of Forest, Elk, and McKean Counties shall have advanced our knowledge much beyond where it was left by the First Survey at the close of 1841

As to Mr. White's names for the upper and lower members of the Great Conglomerate (Seral Conglomerate, Millstone Grit, or No. XII of the Old Survey) viz: Tionesta Sandstone above, and Connoquenessing Sandstone below, it will be seen from Mr. Chance's report of his surveys along the Beaver, Shenango, and Upper Connoquenessing waters (to appear in a forthcoming volume with Mr White's Report on Lawrence County and the Ohio State Line) that the local names Upper and Lower Homewood Sandstones have been used as synonymes

The geology of this basal portion of the column of Coal Measures will be discussed in Report of Progress QQ by Mr. White and Mr. Chance; and in Report of Progress I I I. by Mr. Carll.

§ 7 The great sandstone deposits, described by Mr. White in this Report under the following local names. —Pittsburgh SS.—Morgantown SS.—[Girties Run] SS—Buffalo SS.—Mahoning SS—Butler SS—Freeport SS—Kittanning SS.—Homewood SS—[Tionesta SS]—Connoquenessing SS.—make a new and striking feature of the survey of Western Pennsylvania. The extraordinary variations in the coarseness and size of these deposits will be noticed by reference to the three Geological Indexes at the end of the volume; and their influence upon the shape of the surface of the country, by reference to the word "Cliff," in the General Index. The ranges of cliffs, deep tortuous gorges or cañons, picturesque water falls, masses of fallen fragments as large as houses, on the one hand, and the isolated knobs which stud the upland and occasionally preserve small outlying patches of the Pittsburgh coal bed, on the other hand, are described in detail throughout the report.

When it is remembered that the only well-marked sandstones of the Coal Measures at first recognized by the old survey were the Mahoning, the Freeport, the Tionesta and the Conglomerate, to which were afterward added the Pittsburgh* (or Connellsville), and the great Upper Coal Series Sandstone, referred by me in my Coal Manual to the Anvil Rock of Kentucky, it is no uncertain proof of the thoroughness with which the State is now being studied to find that so many additional well-defined and important outspreads of sand and gravel between the coal beds have not only received special names, but have been traced and identified from county to county over the greater part of the coal field.

The Morgantown Sandstone, for example, lying from 150 to 200 feet beneath the Pittsburg Coal Bed, and so named by Prof. Stevenson from Morgantown in West Virginia, where it is finely exhibited and where it was first thoroughly studied, has now been recognized everywhere in Cambria, Somerset, Indiana, Westmoreland, Fayette, Alleghany, Butler and Beaver Counties where the hills are high enough to preserve it, and along the borders of Greene and Washington Counties; but it does not appear in Mr. Jones' reproduction of Prof. Tyson's old Section† in the Cumberland Basin in Maryland. It takes rank therefore with the Mahoning Sandstone and the Conglomerate No. XII, as marking a period of general emergence, erosion, subsequent subsidence and local nonconformability of deposits toward the close of the (Lower) Barren Measure Age.

---

*This is the *Lower* Pittsburgh Sandstone some distance underneath the Pittsburgh Coal bed, and not the *Upper* Pittsburgh Sandstone, overlying the Coal bed.

† HHH. p 64, plate VI.

The Girties Run* Sandstone, 400′ below the Pittsburgh Coal, occupies an horizon where massive sandrocks occur in other parts of the Coal Field Although apparently local in Mr. White's district, it will probably be found to be co-extensive with the area of the Barren Measures. In fact Prof. Stevenson is prepared to show that the great cliffs opposite Saltzburg, on the Kiskiminitas, consist of the Girties Run, Buffalo, and Mahoning Sandstones, combined into a nearly solid mass, 200 feet thick; the upper member of this group he calls the Saltzburg Sandstone

The Mahoning Sandstone was long recognized as a composite group, consisting of sand and gravel deposits above and below, with one or more coal beds, fire-clay, and shales between them. They were only known, however, as Upper and Lower Mahoning Sandstone, and no name was ever given to the intermediate Brush Creek coal bed.

Prof. White has found a limestone deposit above the coal; and between the limestone and the coal another massive sandstone.† This unusual development of the group may be peculiar to a limited area. But a coal bed is noticeable at this same horizon in distant districts,‡ and the limestone spreads through fifteen townships of Mr. White's district.

The upper member of the group Mr. White has named the Buffalo Sandstone, because it forms all the gorges debouching upon the valley of the Alleghany River in Butler and Alleghany Counties between Pittsburgh and Tarentum It is 100 feet thick on the Ohio River below Pittsburgh, and forms cliffs along Girtie's run in Shaler, Ross, and McCandless townships, Alleghany County § Throughout central Beaver County, it is frequently a thick deposit of shale, and it is not massive along the Ohio river below Haysville; but it becomes massive and pebbly near the Ohio State line

It is unnecessary to repeat the above statements in reference to sandrocks lower down in the column and forming parts of the Freeport and Clarion groups. The reader is referred to the report itself to learn their individual importance. But too serious attention cannot be given to one feature common to all these sandrock deposits . their local irregularity both of size and coarseness of material. They vary in thickness rapidly and frequently within small areas, and graduate not only vertically but horizontally from sandstone into conglomerate and from sandstone into shale. If we could map them they would probably present a striking resemblance to the sands of the Oil Region, and be seen to run like them in comparatively long and narrow belts, marking lines of current in the open water of the Coal Era, or perhaps channels of deeper water between and among shallows or even islands of finer sand and mud. In some cases they may possibly occupy shallow valleys of erosion, but Mr. White considers the evidence not only insufficient for but hostile to such a supposition.

---

* Bakerstown SS.

† Q page 155

‡ As far as Broad Top in Blair County.

§ See Q. pages 158, 165, 167, 168.

§ 8. The limestone deposits described by Mr. White are more interesting than usual for the specification of the characteristic fossils, the distribution of which may be seen at a glance by reference to the word "Fossil" in the Index. Some of the forms, as *Athyris subtilita* and *Bellerophon carbonarius*, have a vertical range of 600 feet; the former being found from the Crinoidal Limestone down to the Mercer Limestone, and the latter from the Crinoidal down to the Ferriferous. Some of these limestone beds are in places a mere mass of shells and encrinal fragments.

The Encrinal Limestone, or Green Limestone of the Old Survey, has now been recognized at its regular horizon midway between the Pittsburgh and Freeport coals from Somerset County to Beaver County

§ 9 The fossil plant bed described on pages 54 to 56, and mined by Mr Mansfield near Darlington, will arrest the reader's attention. Since putting the report into type Mr. Lesquereux writes that Mr. Mansfield continues to transmit for his examination boxes of specimens to enlarge the list of species It is a rare and precious locality for the botanist; and the Survey is under heavy obligations to Mr. Mansfield for his zealous efforts to get for it the full advantage of the opportunity.

The first indubitable mushroom ever discovered in any Coal Measures is one of the treasures of this collection. Mr. Lesquereux's description of it, read at a meeting of the American Philosophical Society, October 19, 1877, will be found in full on pages xlvii to li at the end of this preface

The discovery of a crustacean, allied to *Eurypterus*, and called by Mr. C. E. Hall *Dolichopterus Mansfieldi*, in the Darlington shales, is described on page 72. The Eurypterus, formerly supposed to be peculiar to the Water Lime (Lower Helderberg) formation (No. VI of Pennsylvania), has been found in much higher rocks by Mr. Carll in Venango County. *Eurypterus pulicaris* was found in the English Coal Measures and described by Salter in the Quar. Jour. Geol. Soc., London, Vol. XIX, 1863. *Eurypterus mazonensis*, from the Illinois Coal Measures, was described by Meek and Worthen in the Amer. Jour Sci and Arts, Vol XLVI, 1868. But the fossil is rare, and Darlington is a great addition to the list of known localities where it may be sought for. Mr. Mansfield has mined from his shales a number of individuals.

§ 10 The lowest point in the surface of the district described in this volume is the surface of the Ohio River at the Ohio State Line. The following Railway and other levels will be of service to the reader of this report. They are all *referred to tide level:*

Highest land in the district, Big Knob, in New Sewickley township, Beaver County, ...	1,450′
Knob in Pine township, Alleghany County, . .	1,395′
Knob in M'Candless township, Alleghany County,	1,375′
Dilke's Station on Butler Branch West Penn R. R ,	1,317′
Hermon Station, " " " .	1,298′
Saxonberg Station, " " " .	1,207′
Monroe Station, " " " .	842′
Pittsburgh: Union Depot, ...	745′
Ohio River at Pittsburgh, High water of 1832, . .	733′
Ohio River, " " " 1852, . .	730′
Ohio River, " City datum, ...	699′
Alleghany Station on the Pittsburgh, Fort Wayne and Chicago R. R., ...	738′

Outer depot, Pittsburgh,	Fort W.	and C.	R. R ,	764′
Wood's run Station,	"	"	"	731′
Jack's run Station,	"	"	"	728′
Bellevue Station,	"	"	"	728′
Emsworth Station,	"	"	"	725′
Dixmont Station,	"	"	"	722′
Glendale Station,	"	"	"	721′
Haysville Station,	"	"	"	721′
Sewickley Station,	"	"	"	736′
Edgeworth Station,	"	"	"	725′
Fair Oaks Station,	"	"	"	715′
Economy Station,	"	"	"	715′
Baden Station,	"	"	"	715′
Remington Station,	"	"	"	715′
Freedom Station,	"	"	"	703′
Rochester (at the mouth of Beaver,)				706′
Beaver Station,	Cleveland	and Pittsburgh	R. R ,	710′
Industry Station,	"	"	"	701′
Smith's Ferry Station,		"	"	699′
Ohio State Line Station,		"	"	703′
Ohio River at the line at ordinary times probably				680′

Along the Beaver River and across North Beaver the following are some of the levels *above tide:*

Ohio State Line Station on the	Pittsburgh,	Fort Wayne and Chicago	R. R., ...	994′
Enon Station,	"	"	"	994′
New Galilee Station,	"	"	"	957′
Darlington Station,	"	"	"	981′
Summit Cut Station,	"	"	"	1,054′
Highland Station,	"	"	"	1,043′
Homewood Station,	"	"	"	949′
Wallace run Station,	"	"	"	895′
Sullivan Station,	"	"	"	865′
Beaver Falls Station,	"	"	"	771′
New Brighton Station,	"	"	"	750′
Rochester Station,	"	"	"	706′
Clinton Station on the	New Castle	and Beaver Valley	R. R., ...	900′
Thompson's,	"	"	"	860′

Wampum Station on the New Castle and Beaver Valley R. R., ...		801′
Newport,	" " "	812′
New Castle,	" " "	803′
[Sandy Lake, head of Beaver, ...		1,313′ (?)*
[Harrisville in North Butler, ...		1,379′ (?)*
[Summit Station, New Castle and Franklin R. R.,		1,388′ (?)*
South of the Ohio River:—		
Pittsburgh Union Depot (as before,)		745′
Birmingham Station on the Pittsburgh, Cincinnati and St. Louis R. R., ...		767′
Jones' Ferry Station,	" "	764′
Temperanceville Station,	" "	769′
Sheridan Station,	" "	871′
Cork Run Station,	" "	881′
Ingram Station,	" "	887′
Broadhead Station,	" "	879′
Cemetary Crossing Station,	" "	874′
Bridge No. 3 Station,	" "	831′
Bridge No. 4 Station,	" "	794′
Bridge No. 5 Station,	" "	782′
Mansfield Station,	" "	782′
Walker's Mill Station,	" "	827′
Oakdale Station,	" "	915′
Noblestown Station,	" "	930′
Willow Grove Station,	" "	995′
McDonald's Station,	" "	998′
Primrose Station,	" "	1,030′
Bulger Station,	" "	1,153′
Bridge No 17 Station,	" "	1,229′
Burgettstown Station,	" "	1,008′
Dinsmore Station,	" "	1,089′
Bridge No. 19 Station,	" "	882′
Paris road Station,	" "	865′
Bridge No. 22 (in Pennsylvania,)	"	836′
Colliers (in Virginia) Station,	" "	833′
Steubenville (on the Ohio River) Station,	"	663′

---

* Given for comparison with the upland levels discussed further on.

Mansfield (again as above and going south into Washington County up the Valley of Chartiers Creek,	782′
Leasdale Station on the Chartier's R. R.,	808′
Woodville, " " "	813′
Bridgeville, " " "	831′
Boyce's, " " "	874′
Hill's, " " "	879′
Greer's, " " "	902′
Van Emman's, " " "	931′
Cannonsburg, " " "	942′
Houston's, " " "	958′
Ewing's Mills, " " "	987′
Cook's, " " "	1,012′
Washington (County town,)	1,055′
Levels along the National Road between the Monongahela River and Washington.—	
School-house, three miles from the River,	1,195′
Kreppsville, " " " "	1,225′
Just east from Centreville, " "	1,185′
Centreville, " " " "	1,225′
Hills at Centreville, " " "	1,245′
North from Centreville, " "	1,285′
Just east from Bealsville, " "	1,285′
Terrace on hill west from Beallsville,	1,445′
On next Summit, " "	1,475′
Hillsborough, " 1,295′, 1,380′, 1,430′, 1,445′,	1,475′
At the top of the hill, " " "	1,505′
Thence to within two miles of Washington, the national road oscillates between 1,380′ and 1,295′ or 1,285′; only twice reaching the level of,	1,420′
and once the level of, " "	1,430′ or 1,435′
From this ridge the country on each side falls off in a series of beautiful steps; none of the hills rising higher than,	1,505′

§ 11. The above imperfect list of levels taken both in the valley bottoms and on the high lands will enable the reader better to comprehend two important subjects discussed by

Prof. White in this Report, 1. the *Terraces* of the Beaver and Ohio Rivers, and 2. the *Buried Valleys*[*] of Beaver County. See Chapter II.

The Terraces of the Monongahela River are described in Prof. Stevenson's Report of Progress K, pages 11 to 19.

Near the Virginia line four terraces are visible at 310′, 250′, 180′, and 20′, respectively, above the river bed. The Carmichael 250′ terrace is especially marked, and gravelly, and forms a plain.

At Ten-mile run the terraces stand at 310′, 185′, and 20′ above the river; and there are indications of the former existence of one at 400′.

The Carmichael terrace is seen in the form of a plain again at Clarksville.

Below and back of Frederick is a terrace at 410′.

The Belvernon terrace is at 180′.

At Monongahela City seven terraces may be counted at levels above the river, 480′, 400′, 340′, 290′, 190′, 120′, 40′.

From this down to Pittsburgh the 290′ and 190′ terraces are constant. The 290′ terrace appears on both sides of the river at Peters' Creek, at Thompson's run, and opposite the Alleghany Co. Poor House. "This seems to be the upper limit of large water-worn fragments along the lower portion of the Monongahela River. The higher terraces are very fragmentary."

---

[*] To the distinguished State Geologist of Ohio, Dr. Newberry, is due the credit of pronouncing distinctly, proving and explaining the existence of buried valleys, now filled more or less fully with glacial and other drift deposits, in Ohio, Kentucky, and other Western States. The careful study which James Hall made of similar buried valleys in his Western Geological District of the State of New York, in the years preceding the publication of his Quarto Report in 1843, is well known. Both the Niagara River and the Genessee River do not now flow down from the highlands into Lake Ontario through their original cañons, which were filled with gravel by the ice—gravel which these rivers would not or could not afterwards remove—but through new cañons trenched subsequently, and through the solid rock.

Prof. White, in this Report (pp. Q. 14 +), describes the ancient buried valley of the Beaver River, and adds some new features to the picture which require careful consideration; especially the fact that the rock bed of the Little Beaver valley is on a higher level than that of the Ohio valley, into which it debouches, and the same is true of the bed of the Connoquenessing, where it enters the Beaver, and the beds of all the lateral ravines.

On the Ohio River below Pittsburgh at the mouth of Chartiers Creek six terraces appear at 390′ and lower levels.

A terrace, continuous along Chartiers Creek from Cook's station to Bridgeville, and on which Grafton Station stands, shows the following *slope* of its level:—

Cook's station terrace, above creek at Cook's station,	25′
Bridgeville terrace, above creek at Bridgeville, . . .	75′
Cook's station terrace, above creek at Bridgeville,	205′
Fall of Chartiers creek itself, ...	180′
Fall of the Terrace level itself, ...	130′

This shows that no one of these terraces is by any means on a dead level. These Chartiers Valley terraces continue to its head, and contain limestone drift *from the south*

On Montour's run a still more marked terrace is traceable for several miles in Alleghany County, falling less rapidly than the run, viz: at the rate of 35′ in 4 miles (in relation to the run); but it has not been successfully connected with any of the terraces on the Ohio River bluffs, although it seems to be the third.

On the Ohio, back of Middletown, are four terraces at 410′, 350′, 200′, 30′ above low water.

The 410′ forms "a broad plain several miles wide, north and south, and extending back from the river on both sides to low hills, which separate it from the higher land in the interior." No polished or transported fragments are seen on it, but only the well known terrace-sands and terrace-clays.

The 350′ terrace shows occasional rolled stones.

The 200′ terrace is rich in them.

The 30′ or "Second Bottom" terrace, on which Middletown is built, is paved with them.

In South Beaver County the Ohio is lined with three persistent terraces at 100′ (to 120′), 60′ (to 80′), and 30′ above low water mark. On the 100′ stand Beaver and Georgetown, and on the 60′ Phillipstown. The highest water-worn fragments observed by Mr. White south of the river lay at 120′.

The Raccoon Creek terraces (well marked) stand at New Sheffield at 180′ and 165′ above the creek.

Such are the data to be obtained from Report K, on which Prof Stevenson bases conclusions stated on pages K 16 to K 19

In the present volume Mr. White gives new and important additional data, grouping his Ohio and Beaver River continuous terraces thus (see pages Q 10, Q 11,) in reference to the river water levels :

Fifth ; upper part of Bellevue, ...	280′ to 300′
Fourth ; much eroded, and seldom seen, . .	200′ to 220′
Third ; Economy, Beaver, Georgetown, . .	120′ to 130′
Second ; Sewickley, Philipsburg, &c., . . .	60′ to 80′
First ; =Flood plain of the Ohio ; islands, .	30′ to 40′

At New Brighton the succession is well marked, and is referred to the Beaver River water level and approximate to tide level* thus :—

Fourth, above Beaver, .	215′ ; above tide, . .	885′ ?
Third, " " . .	125′ ; " " . .	795′ ?
Second,* " " . .	80′ ; " " . .	750′ ?
First, " " . .	30′ ; " " . .	700′ ?

On pages 12, 13, will be found a section showing that the 215′ terrace consists of a layer of sand, with an occasional rounded boulder of sandstone, 6″ to 10″ thick, under which lie 5′ to 8′ of potter's clay. It hangs on a rock cliff, and is cut off from all apparent connection with the other three terraces below it by 75′ of outcropping coal measures.

The 125′, 80′ and 30′ terraces are merely three steps in a solid mass of rounded and polished boulders of granite, gneiss, conglomerate, sandstone, limestone, &c., varying in size from 1″ to 10″, and lying in immediate contact with each other, the interstices being filled with small pebbles and sand. Wells have been sunk 125′ through this deposit without touching its floor. It once filled up the valley of the Ohio from bluff to bluff. The river has cut its modern channel through it without reaching its bottom. The piers of the R. R bridge across the mouth of the Beaver

---

*On this second terrace, the railroad runs.

River go down 60′ beneath water level in this drift. It is probably much deeper in other places, and the whole deposit more than 300′ feet deep, measuring from the top of the 125′ terrace.

The materials above enumerated must have come either from the Blue Ridge of Virginia, or from the Laurentian Mountains in Canada and north-eastern New York, gathering up and mixing with *noncrystalline* fragments from the Palæozoic formations in their course.

But it seems incredible that they came from the Blue Ridge range, that is from the east and south-east, because Prof. Stevenson reports their total absence from the Monongahela Valley terraces. The Belvernon terrace, only 180′ above low water mark of the Monongahela River, and therefore *about* 850′ above tide, consists of (see p. K 13) alternate fire clay, gravel, and coarse sand and *broken coal*, 12′ to 15′ at top; then (going down) fine, angular glass-sand, layers of clay, layers of conglomerate, with many large rounded fragments of limestone, sandstone, and conglomerate, 16′ to 22′; under this, coarse sand and gravel, small rounded fragments, coal, lignite, large fragments of trees, 2′; then, sand, 2′ to 4′; then, blue clay, 0 to 4′, at the bottom.

Surely there would be seen some traces of granitic, gneissoid, shistose drift along the valley if *through it* the drift of the lower terraces of the Ohio River had made its way northward. In fact, on the supposition of a south-east origin for the azoic pebbles of the Ohio Valley the Monongahela terraces ought to present even a more azoic type of features than the Ohio River terraces do.

On the other hand, on the supposition of a northern origin nothing but ice could have brought the azoic materials from such distances in the north and north-east. The nearest mother rocks from which granite and gneiss fragments could be got are in the mountains north of Albany, distant in a straight line about 450 miles. No water current bearing *these* rocks over the highlands of northern Pennsylvania is conceivable For such a current, after reaching Pittsburgh, must have set up the Monongahela Valley as well down the Ohio Valley. There will be occasion directly to speak of such a current in reference to the highest terraces and blocks on the hill tops ; but at present we are dealing with a deposit of northern drift filling the ancient valley of the Beaver and Ohio Rivers, from an unknown depth (say 200′) to a height of less than 200′ above present river level.

The ice agent is one well known in eastern and northern Pennsylvania. A broad sheet of ice once moved over these parts of the State, and has left its grooves and scratches on the crests of the mountains, even on the flat top of the Penobscot Knob above Wilkesbarre, about 2,200′ above the present sea level; and it sent down finger-like glaciers to within a few miles of Harrisburg and Easton. Its worn fragments, carried still further forward by the river floods, surround Philadelphia.

It is not necessary to suppose that the ice sheet, or even its finger-end glaciers, came anywhere near Pittsburgh, for the rivers would distribute the moraine matter.

But the ice itself certainly reached as far south as Sharon, or within 40 miles of the Ohio river, for the surface of the conglomerate is there covered with glacial scratches; and perhaps 25 miles further, for a continuous coat of drift is spread over the hills as far south as Moravia, 5 miles south of New Castle. Mr. Chance even thinks that he has seen horizontal ice grooves on the rock wall of the Beaver Valley below Beaver Falls, within four or five miles of the Ohio River.

The conclusion is, however, inevitable that there was water to receive this stuff in the Ohio River valley below Pittsburgh, standing at a level of at least 200′ above the present river bed.

Was this standing water; or was it a tumultuously rushing flood? Was it fresh water; or was it salt? These are questions which we are not yet able to answer.

If it were standing water, it may have been that of a fresh water lake with an ice barrier to the north. But where can we find any dam for this lake towards the south-west, in the direction of the open Mississippi country?

Or it may have been standing salt water. Then the ocean level must have stood nearly 1,000′ above its present level, and all the Atlantic seaboard and most of the Western States must have been submerged. Lake Erie should have been 400′ under the sea.

If it were a rushing flood, then it could have been produced only by the rapid melting of the ice sheet of the north at the close of the Glacial Age.

Rushing water, however, would not have failed to invade the Monongahela valley unless it were met by rushing water descending that valley to meet and unite with it. This involves the supposition that the ice lay thick along the Alleghany Back Bone and over West Virginia, around the heads of Cheat River, and the simultaneous and equally rapid melting of this ice as well as of the main body of ice in the north.

Railroad grade at New Brighton on the Beaver River (750′) and railroad grade at Monongahela City (737′) are nearly the same, there being only 13′ difference. Consequently, the top of the Northern Drift terrace (3d, 795′) at N. Brighton, is nearly on a level with the Second terrace at Monongahela City (857′), *i. e.* about 50′ difference. Yet this terrace is composed of coal-measure or southern drift. There must have been some good reason for so striking an exclusion of northern drift from this southern main branch of the Ohio River; and certainly no glacier or glacial water current could have set up through it. Indeed, all the land to the south is too high to furnish any outlet for such a current.

Where the Baltimore and Ohio R. R. crosses the Cheat River its grade is 1,397′, instead of 795′ the height of the terrace top; and where it crosses the deep channel of the Monongahela at Fairmount, in W. Virginia, its grade is 888′. The Glover's Gap tunnel through the divide to the west is at 1,150′, and although it sinks again to 887′ in crossing

N. Fork of Fish Creek, it crosses the divide towards Wheeling through the Welling Tunnel at 1,193′.

In a word, the water and ice movements of the ice-and ice-and after-ice age must have taken the direction of the present river channels.

Passing now to a consideration of the Upper or 4th terrace at New Brighton, its top is at a level of 215′ above low water, or (about 885′ above tide); and its sand and clay character, and isolation from the Northern Drift deposit beneath it, plainly speak of a subsequent age and entirely different method of formation. In fact, it resembles the terraces of the Monongahela Valley. But its height is very moderate. The 5th terrace at Bellevue, higher up the Ohio, is 280′ to 300′ above low water, equal to 1,030′ to 1,050′ above tide. As we ascend the river the top terrace becomes still higher; at Chartiers Creek mouth 390′ (about 1,090′ above tide); and at Monongahela City, the 7th terrace, 480′ (about 1,200′ above tide); and Prof. Stevenson describes the great terrace-plain of Brush Ridge in Fayette County, east of the Monongahela, as 1,290′ above tide.*

Although Prof. Stevenson draws attention to the fact

---

*As the oil well borings have amply proven that the valleys of the Mahoning and Beaver were originally one or two hundred feet deeper than they are now, their beds having been filled to that depth with gravel, &c from the north, so, oil wells in the northern counties have proven that the elevated valleys in which French Creek, Oil Creek, the Brokenstraw, the Connawango, and the Allegheny River itself, now flow (all of them southward) were once much deeper, for pipes have to be driven through loose sand and gravel for 50′ or 100′, and even 200′, below the nearly level surface. Mr Carll in his forthcoming Report (III) will show all this, and the stopped up gates at Franklin, Titusville, and other points (stopped with drift and reopened more recently); and prove that the *original or preglacial drainage of his district was northward into Lake Erie.*

The broad sloping plains of soft material on top and of gravel below, into which the northern wells were bored, are still existing specimens of the above described system of broad sloping plains of clays and sand, based on gravel, which existed in the Monongahela country when the new rivers began the excavation of the present valleys. Had such large rivers worked in the north (instead of rills and runs only) the stuff of these northern plains would also ere this have disappeared, and nothing would now remain of the plains on record but a top terrace or two in patches here and there. In fact, that process did take effect to some extent, and Mr Carll has *terraces* of that nature to describe.

(page K, 17) that "at every locality in the Monongahela valley where an exposure occurred it was seen that *the terrace is merely a shelf worn out of the stratified rocks, on which the river has spread a thin layer of detritus*" it seems to me probable that the Monongahela Valley was once filled from wall to wall with a recent deposit of clay and sand to a maximum height of 1,290′ above tide, or to a maximum depth of 1,290′—750′=540′ over its present bed; and that this deposit has been reexcavated, of course by the river itself, in the course of ages, excepting only such patches on the ridges as rested on previous terraces of erosion, benches of solid coal-measures—and excepting also what was left spread abroad as great clay and sand plains over the uplands at a height of 1,290′.*

It would follow that the upper Later Terrace Deposit was not only a broad plain in the Monongahela country, but had a sloping surface towards Pittsburgh, falling from 1,290′ to 1,090′, and still sloping down the valley of the Ohio River to 935′, and even lower, before it reached the Ohio State Line.

But if this view be correct, then the whole of so much of the surface of South-Western Pennsylvania as lay below the contour line of 1,290′ was at one time under water, and so into the bays and branches of this still water was brought, by every river and creek and run, sand and mud; each bringing, according to its ability or area of drainage, the waste of the unsubmerged Coal Measure surface behind and around it, and dumping it first at the heads of the bays, and so further and further on down, but also less and less deep, until the original Ohio River valley (*already filled up to a depth of 300′ or 350′ with the First, Northern or Glacial Drift*) was still further filled with a top covering of Second or Local Clay and Sand deposits to various heights above tide from 900′ to 1,100′; and the Monongahela Valley

---

*To this opinion however Mr. White emphatically demurs He looks upon the upper clay terraces as *older* not younger than the lower drift terraces He can not see any evidence for the subsequent filling up the valleys, but considers the upper terraces as fragments of river-banks when the rivers flowed at their respective levels. In this opinion he agrees with Prof. Stevenson.

which never had received the first drift, to a height of from 1,100′ to 1,290′.

§ 12. Before considering the nature of this submergence, it is well to notice Mr. White's interesting statements respecting "Perched Blocks," for they become an important item of our information, and lead directly to two conclusions, 1. the one already argued, namely the universal submergence up to 1,290′, and 2. the necessity for increasing the depth of that submergence somewhat, say to 1,300′ or even 1,400′ above present tide level

Masses of granite, erratic from far northern regions, lie perched upon the highest hill tops of Beaver County, west of the Beaver River and north of the Ohio River. Confined to that district none have been seen east of the one river nor south of the other. Very numerous in places, and varying in size from a few inches to several feet, (and one is known to have been 10′ x 8′ x 6′ see page 10 Q) they are found at a maximum height of 1,300′ above tide.

Ice-bergs, or floes of ground-ice, are the only carriers of such rocks to such localities; and these carriers must have floated at that or at a still higher elevation. This proves the submergence of the district But had the submergence been much greater than to 1,300′ the country between the Beaver and Alleghany rivers would have received its share of ice droppings; and so might the country to the south of the Ohio river.

It is evident that the current which brought the granite-laden ice, not only descended the broad valley of the Beaver and Shenango Rivers, but turned down the valley of the Ohio River and floated the ice onward so as to drop its stones on the hills of South-Eastern Ohio

Three prominent knobs stand up above the general hill-country east of the Beaver River: Big Knob, in New Sewickley township 1,450′; a knob in McCandless township, 1,375′; and a knob in Pine township* 1,395′ above present tide level. The first is an outlying relic of Morgantown Sandstone; the other two are outlying relics of Upper Pittsburgh Sandstone protecting patches of the Pittsburgh Coal bed. Judging by their shape alone these knobs must have had their heads above the waters, and stood like islets beaten by the waves. But either they were too small to detain the passing ice-drift; or it was borne far to the west of them by the faster moving central part of the current; or more probably still a slow moving current of warmer water setting from the Monongahela Valley and Virginia kept the Beaver current always to the westward.

---

* See pages Q 27, 30, 189, 190; Q 169, Q 171.

It is needless to seek for the origin of this latter current in any cause other or greater than that which provides the country of the Monongahela with its present noble river or group of rivers and their thousand affluent streams—the annual rain fall—which would supply the smaller branches of the Ohio River also, as it still does. No other difference in the operations of the cause could have occurred beyond this, viz: that all the erosion of the unsubmerged lands and mountain slopes, all the sand and mud which is now swept along for 1,500 miles to form the delta of the Mississippi and fill up the Gulf of Mexico, came then immediately to rest in the deep and wide submerged water-ways of South-Western Pennsylvania. And hence the sloping plane of the Second or Upper Terrace Deposit.

Was the water salt, or fresh?

Even supposing the ocean level to have been raised (or the continent sunk) by the required 1,300′, the rain fall current flowing northward and westward through these land-locked avenues would make their waters, if not fresh, at least brackish; especially considering the comparatively short time during which the submergence lasted; for its recent occurrence is proven by the earlier and underlying Northern Drift Deposit.

How far did the 1,300′ level carry this (salt or fresh) standing water up the present river valleys of Western Pennsylvania?

Up Chartiers Creek, the water stood over Washington R. R. Station 250′.

Up Ten Mile Creek, and Dunkard's Creek, and along the Baltimore and Ohio R. R., west of the Monongahela, the 1,300′ level would allow the water to flow over the passes into the valleys on the Steubenville and Wheeling side of that highland

Water at 1,300′ would stand 300′ above Grafton; would ascend the Cheat River nearly to Rowlesburg; would reach on the Youghiogheny River to Confluence; on the Loyalhanna River to the middle of its gap; on the Conemaugh River to Conemaugh Station on the Pennsylvania R. R and Johnstown would be submerged 100 feet; on Sandy, to near the mouth of Paint in Somerset County; on Black Lick and Two Lick, into their gaps, and exactly to the county town of Indiana, which, like Confluence, would then be situated at the pointed end of a long narrow arm of the sea; on the Mahoning River branches, to within five miles of the Clearfield County line; on the Red Bank, to Bell's Mills above Brookville which would be just left dry; on the Clarion to ; and on the Alleghany River to the New York State Line, Oil City being under water 300′, and Warren 100′.

East Sandy, Tionesta and Kenzua valleys would be three pointed bays ten or twenty miles long

Warren being submerged 100′ the valley of the Conewango and its branch the Cassadaga would be flooded far into New York, nearly to Chautauque Station within 14 miles of Dunkirk, and an extra rise of 20′ would pass the water over the divide. Chautauque lake would become the head of a separate side bay to the west.

Ascending Oil Creek Valley the water of the 1,300′ level above tide would pass Titusville (submerged 120′) and reach Centreville on Oil Creek in north-eastern Crawford County.

Franklin being submerged 300′ French Creek would be flooded across the P. & E. railroad at Le Bœuf Station and beyond it nearly to the south-west corner of the State of New York. But all connection between this French Cr. bay and that of Oil Creek is cut off by an isthmus of high land bordering Oil Creek on the west and extending down to Franklin. But the top of this ridge would nowhere be more than 200′ or 250′ out of water.

From Franklin to Pittsburgh only very short and steep ravines descend to the west bank of the Alleghany River. The crest of the Butler Oil Belt would be a little out of water. Butler itself would be submerged 300′; but Harrisville, in north-western Butler County, would be 50′ out of water. The whole drainage of this country is south-westward into the water basin of the Beaver River; and a general submergence to the 1,300′ level above tide would make an open sea or broad strait running north and south from Beaver town to Erie. All the main branches of Slippery Rock would make tributary bays The Neshannock Valley would be flooded to Garrit Station; Mercertown would have 200′ of water over it, and Evansburg in Crawford about 20′. The water would stand 160′ deep over the R. R summit north-west of Conneaut Lake Meadville Station would be 130′ under water, and the whole Meadville Plain with Conneaut Lake and the Pymatuning Swamp would be merged in the Northern Sea

It can be readily seen how all Mr. Carll's observations of Drift-plains, Hills of moraine-matter, and Buried river-valleys may appear in this new light cast upon them from the evidences of a 1,300′ submergence of Mr White's more southern district; and how easily we can now explain the hitherto anomalous fact that the Canadian ice-droppings are confined to the west side of the Beaver River; for there was a low but complete and entire barrier of unsubmerged land entirely encircling the Alleghany River water-basin; while there was an unobstructed water way for southward-floating ice to the westward of it. While some, perhaps most, of the ice moved across Northern Ohio, so much of it as entered the strait in the neighborhood of Jamestown was compelled to proceed down the Shenango, the Beaver and the Ohio Rivers towards Wheeling

The movement of the ice through this strait might continue not only so long as the 1,300′ level was maintained but until the level declined to 1,150′, when the barrier in western Crawford must have begun to appear above the declining flood, after which event no more granite erratics could reach the hills of Beaver County.

A pipe-line route has been recently levelled by Chief

Engineer Hermann Haupt and his assistants, from Monterey Station on the Alleghany Valley R. R. above the mouth of Redbank—to Baltimore. (See Proceedings of the American Philosophical Society, October 5, 1877, page 136, *et seq.*, where the condensed notes of this valuable survey are published.)

The zero of the survey 824′* near Monterey was taken at the entrance to McElroy's Coal Mine; the water in Redbank was crossed at 839′, and the Mahoning water at 794′.

This line, crossing highlands as well as valleys, shows that land 1,500′ high (above tide) closely borders the Allegheny river valley, at Monterey, on the east; 1,436′, north of Redbank Creek mouth; 1,535′, between the gorges of the Redbank and the Mahoning; and 1,550′, immediately south of the Mahoning.

Crossing the Armstrong-Indiana County Line, and passing Smikesburg over summits of 1,460′ and 1,490′, and depressions of 1,305′, 1,278′, &c.; Georgeville and Marion, with summits of 1,513′, 1,494′ and 1,680′, and depressions (Litt Mahon head runs) of 1,259′ and 1,392′; it finds a ridge separating Mahoning and Two Lick, 1,671′ (Two Lick 1,374′); and between Two Lick and the Susquehanna, 1,962′, 1,986′ and 1,999.20′ (a high knob near the Cambria County Line), declining eastward to 1,905′ and 1,830′. Even the water-way of Two Lick at Rapine's Old Saw Mill stands at 1,510′

The same high land stretches across Cambria County, separating the Susquehanna waters which flow northward from the Conemaugh waters which flow in the opposite direction, and joining the Alleghany mountain crest. Even where the pipe line crosses Clearfield Creek on the north slope of this divide it is 1,600′. The depressions in the divide vary from 1,687 to 1,910′, while its maximum levels vary from 1,981′ to 2,194′†. The high knobs of the Alleghany Mountain Crest range in height between 2,410′ and 2,590′ northward from Gallitzen, and between 2,550′ and 2,830′ southward from Gallitzen. The gaps through which

---

*** Above tide level.**

† Hill back of Ebensburg, 2,170′. See Report HH p xviii to xxii.

the Pennsylvania R. R. tunnel in Cambria County and the Baltimore and Pittsburgh R. R. tunnel in Somerset County are driven are respectively 2,286′ and 2,280′ above tide, (the tunnels being at 2,226′ and 2,161′) The knobs along Laurel Hill rise to 2,470′.

This fairly represents the level of the surface of Clearfield, Jefferson, Forest, Elk, McKean, Potter, Cameron, Lycoming, Wyoming, Sullivan and portions of counties adjoining them constituting an extensive mountain forest belt of western and northern Pennsylvania

But there is one noticeable break-down of this elevated plateau across Clearfield and Jefferson counties; and advantage has been taken of it to make the Low Grade R. R. connection between the Susquehanna and Alleghany rivers, known by the name of the Bennett's Branch Extension of the A. V. R. R. by way of Red Bank and Sandy creeks. This low divide is only about 1,550′; for the east end of the tunnel is 1,440′ above tide. It is sufficient however to have prevented the extension of the 1,300′ level water in that direction. The isolation of the 1,300′ level area from Middle Pennsylvania, Maryland, and Virginia is therefore complete.

It can hardly be supposed however that the Atlantic Ocean did not then beat against the slopes of every mountain in Eastern Pennsylvania which lifts its long and sharp straight crest too high for the submergence. R. R grade at Altoona is only 1,178′ and the horseshoe curve in the Kittanning Point ravine behind it is 1,594′ above tide. In the Valley of the West Branch of the Susquehanna the water would reach to Rathbon Station in Elk County (1,299.18′ *uncorrected* level of 1875) in the valley of Bennett's Branch, to Hebner's run Station beyond Caledonia; and in the gorges of the Sinnemahoning, Kettle Creek and Pine Creek to corresponding distances in the interior of the great plateau. These valleys would then resemble that of the Hudson River between New York and Albany, inasmuch as the latter is now a submerged ancient valley in process of being buried up under an inroad of detritus; coarse in places (and in the spring-time) from the Adirondack, Catskill, Taghkonic mountains, and Highland range; and fine in other parts and seasons from the limestone and shale valleys and the inflowing tides. The Coast Survey has shown that the ancient valley of the Hudson extends many miles out to sea, which proves that the Atlantic Seaboard has suffered a depression of 1,000′ *below* present sea level There is no difficulty then in the way of supposing it elevated previously, in or after the Glacial Age, to a height of 1,300 feet *above* sea level. It is of course an open question whether the ocean itself has not alternately risen and sunk, instead of the continent. But the discussion of this physical problem would be here out of place, and its solution is of no importance whatever in drawing conclusions affecting the buried valleys and perched blocks of Western Pennsylvania. It will come in place in future reports on the erosion and drift deposits of Middle and Eastern Pennsylvania, for which our data are not yet sufficiently numerous nor sufficiently precise. The object held in view in all that has been said above has been to fix the intelligent attention of the geologists of the different districts of the State on the desirableness of closely observing and copiously annotating all the surface phenomena encountered in the progress of their work, and to suggest a right method of collating, comparing and reasoning on observed data, as district after district shall furnish its complement of facts.

If the conclusions arrived at above should prove to be worthy of acceptance, it would follow:

First, that the reexcavation of our western valleys has been accomplished by a second generation of rivers essentially like the first and occupying mainly the same lines upon the map.

Secondly, that the method adopted by the reëxcavating rivers was essentially the same as that pursued by their ancestors, the previous excavating rivers; but a method *modified* to suit a changed condition of things, in as much as the work of the earlier set had been entirely in the old hard rocks, the Coal Measures, while the labor of the later set was expended upon several hundred feet of recent and therefore soft mud and sand; at least until the lower 300 feet of coarse Northern Drift was reached. The older rivers had been confined to deep trench-like valleys; the younger rivers meandered from side to side over wider gently sloping marshy plains.

Thirdly, that any theory which assigns our Topography to a recent date must be a mistaken one; that no Glacial theory at all can apply to it; that no other agent than the rain-fall can have sculptured the main features of the country; and therefore that this carving must have commenced immediately after the Coal Measures were lifted continentally thousands of feet into the air; that it has proceeded ever since; therefore, that the actual valleys are of great geological antiquity; and, finally, that the Drift stuff which fills the bottom of some valleys and the Terrace sands and clays which once filled them all to various heights, and portions of which still cling to their walls, belongs to the latest of the geological ages, viz: that immediately preceding or cotemporaneous with the creation of the mastodon and man.*

Although the reexcavation of the valleys since the glacial age has been a slow and laborious operation occupying many thousand years, the original excavation of the valleys previous to the glacial age must have occupied an immensely longer time, beginning indeed with the emergence of the Coal Measures, and continuing without intermission through the Middle Secondary, Newer Secondary, and Tertiary ages. Not only were the valleys deepening all that time, but the whole surface of the continental highlands was being constantly brought down nearer to the level of the sea. It is in view of this phenomenon that Mr. White's descriptions of the outlying knobs and patches of Pittsburgh and other coal beds become doubly interesting These show how much further towards the north than they do now the sandstone, limestone and coal beds once spread On the other hand, the erratic blocks which rest on the hill tops show that this general degradation of the surface of the country has been comparatively slight since the Ice age, our topography being indeed by that time established pretty much as we now see it.

---

* In this respect it is interesting to observe that the same superposition of a deposit of loam, fine sand and clay upon an older deposit of coarse gravel characterizes the geology of the surface of all Europe north of the Pyrenees and Alps, and of all Asia north of the Caucasus, Himalaya and Altai mountains, as far as Behring's straits; and still more interesting to learn that the remains of the Mammoth and of Man in the Old World are said to be always found in the lower or coarse gravel beds. The remains of Mastodon preserved in the Pittsburgh High School Museum were found, and others have more recently reported to be still lying, in the gravel bed of the Ohio River, in front of the City point where the two rivers meet. (See page K, 22).

The power of ice to erode a country has been grossly exaggerated. The glacial excavation of great valleys, and even of the chain of the great lake has been frequently asserted, in spite of the absurdity of such a supposition. But one might as well ascribe the depression of the Blue-Grass Country of Middle Kentucky, or that of the Central Basin of Middle Tennessee, or that of the Great Valley of Eastern Tennessee and Virginia to the agency of glaciers During the 1,300′ submergence all these were inland seas or great lakes, like those existing in our day between Canada and the United States. They are excavated in the same Lower Silurian formations with Lake Ontario and Lake Champlain Because these latter happen to remain reservoirs of water, that is no reason for assigning to them a peculiar origin.

In like manner Lakes Erie, Huron and Michigan are in all respects similar to the excavated Devonian and Upper Silurian valleys of Pennsylvania, Virginia, Tennessee and Alabama, except that they hold standing water. Were their outlets deep enough to drain them no one would imagine them due to the action of ice, or think of assigning them a date so recent as that of the Glacial age.

I have repeatedly urged the important consideration that the main agent or condition of erosion is the *chemical solution of the limestone formations*. This is plainly true of all the anticlinal valleys of the Appalachian belt, extending from Canada to the Gulf of Mexico It is evidently true of the limestone basin of Middle Tennessee and of the Blue-Grass country of Kentucky ; for millions of caverns, large and small, sink holes, sinking springs, rivers disappearing under ground and reappearing further on, dark ravines, natural bridges, attest the fact, show the process still going on and explain it in all its details. The sandstone and shale formations have been let fall and disintegrated by the gradual failure of the dissolving limestone formations which were their underground supports.

And what is true of the Alleghanies is true of the Jura, the Pyrenees, the Appenines and all other mountain ranges composed of alternations of thick and thin calcareous and silicious strata, folded more or less into anticlinals and synclinals. It makes no difference whether the eroded country be near the pole or near the equator, the features of erosion are always the same, and its amount stands in proportion to the thickness, intercalation and solubility of the limestone layers, and to the time elapsed.

This will be expressed more fully in future reports of the survey relating to Middle Pennsylvania.

But a more important because more practical subject for thought to the miner and capitalist is furnished by a still older and hitherto little known stage in the process of erosion,—an erosion of the Coal Measures themselves during the age of the formation of the coal beds.

This subject was alluded to by Prof. Stevenson in his report on Greene and Washington counties, K; and it will be more fully discussed by him in his forthcoming report on the Ligonier valley, KKK.

Such an ancient valley of erosion is exposed by the Panhandle railway near Hay's Station in Washington County. At the east end of the cut five formations are visible, the top one being sandstone. In the middle of the cut this top sandstone occupies the whole section, thus:—

Sandstone,		Sandstone, . . .	25′
Sandstone,		Sandy Shale, . .	20′
Sandstone,	. . . . . .	Variegated Shale, .	4′
Sandstone,		Limestone, . .	1½′
Sandstone,		Variegated Shale, .	10′

The phenomenon is worthy of the most critical examination, and is thus described by Professor Stevenson :—

"At Fort Pitt Station, this sandstone is fully 75 feet thick and begins at 40 feet below the *Pittsburgh Coal Bed*, so that it may be the *Connellsville Sandstone*. From this point to perhaps three fourths of a mile beyond Walker's Station, it forms a bold bluff alongside of the run, up which the track passes; but about midway between Walker's and Hay's Stations the bluff suddenly disappears, its place being taken by a grassy bank with a gentle slope, and at Hay's Station the following section was obtained, the lower portion being found in a cut just beyond the disappearance of the sandstone bluffs.

1	*Pittsburgh Coal Bed*,	11′
2	Interval,	70
3.	Flaggy Sandstone,	20′
4	Shale,	3′
5	Limestone,	2′
6	Interval,	40′
7.	Limestone,	1½′
8	Sandy Shale,	35′

"No 5 is the limestone, which is replaced at Fort Pitt. Here it is 75 feet above the track, which makes the total rise of the strata between the appearance and the disappearance of the sandstone nearly 150 feet. The dip of the rocks is about 80 feet per mile, while that of the sandstone is not far from 40 feet, since at the western side the lower as well as the upper limestone has been replaced by the sandstone. Both of these rocks must have been above the surface at the time the erosion took place, and the dip must have been about 40 feet per mile in a south-east direction; but this sandstone belongs to the upper part of the Lower Barren series, *so that the Claysville axis must have existed, in this locality at least, as a distinct fold before the deposition of the Connellsville Sandstone* This eroded valley was traced northward for some distance, the sandstone having been recognized in the same position on the Steubenville pike. Its extent southward is unknown, as in that direction the horizon is nowhere exposed within the State of Pennsylvania.

"On the west side of the Claysville axis, and at a short distance east from Oakdale Station on the Panhandle railroad, the same phenomena are even more fully exposed, for there, in a succession of cuts, both sides of an eroded valley are shown. This valley is filled with a sandstone precisely similar in character and relationship to that occupying the valley between Fort Pitt and Hay's Station.

"The next axis toward the east, the Washington, shows similar erosion. This anticlinal crosses the Monongahela River opposite Pittsburgh, and passes almost directly under the Sheffield steel-works. Just east from that locality, and a little below Birmingham, the following section is exposed alongside of the railroad:

1. Limestone,	3′
2 Shale,	2′
3. Green Limestone,	1′
4 *Coal*,	1′
5. Shale,	6

"Just before reaching the steel-works, the Shale, No. 2, cuts out Nos. 3, 4, and 5, and extends to an unknown depth below the track. This gap occupies the exact plane of the axis, and extends for many yards east and west. On its eastern side, the Crinoidal Limestone dips east, and on the west side it dips west. The shale filling the gap is similar in composition to the main portion of the bed, but is comparatively structureless, being without regular bedding. How far this condition extends is not known. At the south under this axis the horizon is concealed, while northward it has been cut away by the rivers for a long distance.

"A very similar case of ancient erosion is found on the Conemaugh River, almost directly under the crest of the arch of the Blairsville anticlinal. It is thus described in the Report of the First Survey, Vol. II, p. 600:

"In the exposure, which is several hundred yards long, the rocks exhibit striking changes in character: thus, at one point, the shale under the sandstone is 10 feet thick, but in a few rods becomes a sandstone, which rests directly on the coal The shales between the coal seams thicken and thin variously. At one place where this appearance presents itself the coal seemingly terminates in the sandstone. Near the place where these disappear with a west dip beneath the water level the massive sandstone resting on the coal changes wholly to shale for a thickness of 12 feet; the sandstone then presents a vertical wall, 40 or 50 feet thick, in coarse gray massive strata, with irregular lines of deposition along the canal."

"Erosions of smaller extent were seen at many places along the axis. They explain many perplexing variations in detail, which one finds in comparing sections obtained in following up an anticlinal.

"The Nineveh synclinal, in the southern portion of Greene County, shows an intercalated group of rocks, which is altogether wanting in all synclinals except the Waynesburg in the same county. It is absent also from all the anticlinals except in the extreme southern portion of the county, where it barely crosses the Pin Hook axis into the Waynesburg synclinal, along Gray's Fork of Ten-mile Creek." (*Letter dated November, 1877.*)

I was disposed to make reference to the extraordinary local deposit of gravel and sand, at Homewood, cutting out the Ferriferous Limestone, as possibly a similar eroded valley deposit of Coal Measure age. But Prof. White protests against such an assumption on the ground of the nonexistence of visible nonconformability where the plains of erosion ought to exhibit such. He thinks the deposit of the sands and gravel synchronous with that of the shales, the one set changing into the other. He points to the fact that the Limestone is not cut off on each side sharp and while at its maximum thickness, but slowly and steadily thins away to a tutenmergal clay, and then to nothing The coal beds were prevented from growing in the shallows, at Homewood because continually swept by the waves and currents which deposited the gravel; whereas, on the Connoquenessing, three miles distant, slight emergences of the land alternated with slight submergences, permitting ærial vegetation (or the accumulation of vegetable material) at one time, and burying it up at another.

§ 13. The only other subject which need be referred to in this preface is that of Petroleum, and for this the reader must consult the final chapter of the report, and the reproduction, on a very reduced scale, of a map of the Smith's Ferry Oil Field published in the Centennial Atlas of Beaver County, by which the number of wells sunk may be better imagined than described. Records of a few wells in Butler County will be found by reference to the word Wells in the Third Index. But the data are too widely scattered and too unreliable to be of much value, and it would be unwise to anticipate Mr. Carll's forthcoming Second Report on the geology of the Oil Region, which will treat the theme in a systematic manner

J. P. LESLEY.

1008 CLINTON STREET, PHILADELPHIA,
January 1, 1878.

A Species of Fungus recently discovered in the shales of the Darlington Coal Bed (Lower Productive Coal Measures, Alleghany River Series) at Cannelton, in Beaver County, Pennsylvania. (*With a plate.*)

BY LEO LESQUEREUX.

(*Read before the American Philosophical Society, October 19, 1877.*)

The discovery of a *Fungus* in connection with plants of the coal measures is not less remarkable than that of land plants in the Silurian.

Lindley and Hutton, in their Fossil Flora of England, 1831-33, have represented (plate 65 of the first volume) a kidney shaped, round, flattened body, whose outline and surface, marked by zones of alternate density and coloring along the borders, recall somewhat the characters of some of the hard *Fungi* seen upon old trunks of the forests at the present time and known as *Polypores*, *Bolets*, etc., or generally called *Sponge-Mushrooms*. The characters of this fossil organism are so uncertain that the authors themselves, though applying to it the generic name of *Polyporites*, consider as very doubtful its reference to the vegetable kingdom.

Mr. Bowman, the discoverer to whom the species is dedicated as *P. Bowmanni*, remarks, that one of his specimens might be taken for the scale of a fish or of some great Saurian. Since that time no kind of remains referable to *Fungi* has been seen in the coal, except one specimen found in the Anthracite measures near Pottsville, Pa. It is apparently identical with the English species, and does not afford any more light upon its nature. This specimen, however, contradicts by its habitat its reference to the animal kingdom, as no remains of this kind are found in the Anthracite measures of Pennsylvania.

But there are in the Tertiary Lignitic of the Rocky Mountains some clay beds associated with coal wherein are intercalated shaly fragments colored in concentric zones by penetration of iron in such a way that they exactly represent the appearance of the fossils described by the English authors. The zones, about two millimeters wide, are of different hardness, and the soft white ones being more easily disintegrated, they form a series of alternately elevated and depressed concentric bands, similar to those described as characters of the *Polyporites* of the coal

However this may be, we have now from the Carboniferous a fossil plant which is by all its characters positively referable to the *Fungi* This plant, which was discovered under the bark of a *Sigillaria*, is referable to the genus *Rhizomorpha*, a fungose substance which even until the present time has very rarely been recognized with organs of fructification, and is therefore admitted as a kind of *mycelium*, or as the first stage of the life of a *fungus*. Species of various and numerous forms of these vegetable organs are commonly found under the bark of trees, or between layers of decaying wood in the forests, and some have been described under different specific names.

RHIZOMORPHA SIGILLARIÆ, sp. nov.

Pl. I, fig. 9.

Stem flattened, irregular in form, round, polygonal, elongated and linear or amorphous; branches diverging all around, either simple or forking, even anastomosing in various directions, inflated towards the top, club shaped and obtuse or slightly flattened by compression, and marked upon the surface by a netting of narrow wrinkles resembling veins and their divisions in veinlets.

The figure exactly represents the specimen which botanists will easily recognize as bearing the appearance of some of our present so-called species of *Rhizomorpha*. The surface wrinkles, distinctly seen in fig. 9 b enlarged, seem to have been produced by compression and contact of an upper layer of bark reposing upon them. In their normal state the same appearance is remarked upon living forms of these

Fungi. It is the same with the flattened body, the mode of branching, the different size and length of the branches, which are evidently widened and modified in their form and directions according to the space left under the bark for their development

Though no doubt could be entertained about the relation of this organism, which was discovered in detaching the upper layer of bark of a *Sigillaria*, I nevertheless referred the matter to the opinion of some of my corresponding friends, to whom I sent the figure of the plant in order to have every possible evidence on this subject Among others, Dr. Casimir Roumeguére of Toulouse, France, who has large collections of *Fungi* and who is known by numerous scientific memoirs on this difficult branch of botany, answered my request by the communication of many specimens of the different forms of *Rhizomorpha* of our time whose characters are comparable to those of the fossil one Remarking on its relation as far as it could be recognized from the figure of this organism (the same as that reproduced here) he says : I was extremely interested by the examination of your *Rhizomorpha Sigilliariæ* and startled by the appearance of structure which seems to relate that American fossil organism to European congeners ; I have especially examined in comparison the described forms of *Rhizomorpha subcorticalis*, where I find characters which have removed my first hesitation in regard to your views One of these forms, the *teredo* of Persoon, has few ramifications, nerves anastomosing, and the primary branches are flattened, enlarged and rugose as in the fossil specimen from Cannelton. The form *latissima* described by Kick, in the flora of Flanders, from under the bark of *Betula alba*, has a flattened body resulting from the impression or cohesion of some stems, etc

From the specimens communicated to me, most of the forms of R. *subcorticalis* present the mode of anatomosis in abnormal direction, as seen at the base of the branch c. Others have a flattened stem when unfolding under some closely pressed piece of bark ; but the branches generally take their cylindrical form when they come to more space especially where air is accessible. Though it is always difficult to find the top of the branches, they are generally inflated or club-shaped as in the fossil specimen

Dr Roumeguère adds to the dry specimen a figure of R *subcorticalis*, which represents a stem flattened and enlarged, as in the body of our fossil, with branches bearing at the surface small tubercles composing a false *peridium*, one of which, more advanced into maturity, has produced a club shaped body identically similar to those of *Hilaria digitata*, an autonome *Fungus*. This production has been as yet very rarely observed Except that the ramifications of the branches of that living species are longer and not inflated at the top, which is not discernible in the specimen, the fossil form is remarkably similar to it.

I received also from Professor C. H. Peek, of Albany, some specimens of *Rhizomorpha* more or less representing the character of *R. Sigillariæ*.

No fossil plant published until now from any of the geological formations of Europe or of America has any relation to this. In Sternberg, Vers , *Aphlebia tenuiloba*, represented in Vol. II, pl. lviii, Fig 2, might be quoted as bearing some relations to the plant of Cannelton by its branches irregularly diverging from an enlarged amorphous central mucleus. But though this species, a mere variation of *A adnascens*, Pr., represents a parasite plant, it has, like the others described under this generic name, a distinct system of nervation, according to which, the divisions of the primary stems are in an outside or upward direction, and therefore do not, and cannot anatomose either in right angle or in abnormal direction, as is the case with plants of cellular tissue Thus we should have only for comparison, outside of the *Fungi*, marine plants or Fucoids, and of course the presence of marine plants in connection with *Sigillaria*, even under the bark of trees of this kind, is an impossibility.

Habitat. I found this vegetable organism in shaly cannel or cannel shale of the Cannelton coal, of Beaver County, in company with the proprietor, Mr. I. F. Mansfield, who in pursuing systematic researches for fossil remains has obtained a remarkably rich series of rare and new species of plants of the Carboniferous. The character of a rib of Sigillaria is easily recognized upon the figure of the specimen, which bears also one round scar of the under surface. The upper layer of bark transformed into coal was broken into small fragments to fully expose the fossil *Fungus.*

REPORT OF THE PROGRESS

OF THE

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,

IN PARTS OF

BEAVER, ALLEGHENY, AND BUTLER COUNTIES,

LYING NORTH OF THE OHIO RIVER.

BY I. C. WHITE.

PART I.

SUMMARY STATEMENT OF THE GEOLOGY OF THE DISTRICT.

CHAPTER I.

Topography of the Surface and Character of Soil.

The district of Western Pennsylvania described in this Report includes all of Beaver county north from the Ohio river, the southern half of Butler, and that portion of Allegheny lying north from the Ohio, and west from the Allegheny river It thus extends from the Allegheny river to the Ohio State line, and embraces an area of about 900 square miles

The general surface of the country may be described as hilly; for, except along the Ohio river, there is very little valley surface in any portion of the district. There is a great similarity in the topography along all the streams, and when we have described one, we have practically described the surface features along all. This is due, of course, to the similar character of the rocks out of which all have carved their channels; for, with very few exceptions, all the streams which rise within the district have their sources in the Barren Measures, and their mouths in some portion of the Lower Productive Coal Series *

Taking any one of the principal streams and passing from its mouth to its source we would meet with the following surface conditions:

At its mouth, and all along its course through the Lower Coal series, the hills rise very abruptly on either side, often leaving the bed of the stream to occupy the entire valley surface between. They continue steep and rugged until their summits pass above the massive sandstones at the base of the Barren Measures, then the hills slope gently away; their outlines are rounded, and we frequently find broad and almost level stretches of land on their summits

Sometimes the valley will widen out and give us nice bottom lands on each side of the stream for a short distance; but this state of affairs is the exception and not the rule

Frequently the stream flows in a deep gorge with immense cliffs of sandstone rising almost perpendicularly on each side, and this is the case especially when it cuts through the massive rocks at the base of the Barren Measures

Near the head of the stream, where its bed lies above these massive rocks, a great change occurs in the topoggraphy The narrow gorge in which the stream below was flowing becomes a beautiful valley; the steep and rugged hills are replaced by a gently rising surface, which slopes gradually away in the distance; the stream itself becomes sluggish, and the whole area is farming country.

It will thus be seen that nearly all the arable land of the district lies on the high lands, back from the steep bluffs which border all the streams, except near their sources.

There are two principal water-sheds The most important one of these enters the district from the north, in the eastern portion of Butler county, and passing south, forms the divide between the waters flowing east into the Allegheny, and those flowing west into the Connoquenessing.

---

* The term "Barren Measures" will be used in this report instead of Lower Barren Measures, because the Upper Barren Measures are confined to the country further south, and there can be no misunderstanding produced by a convenient return to the use of the term universally employed in the old reports By "Lower Coal Measures" will always be meant Lower Productive Coal Measures.

This divide holds a south course, rudely parallel to the Allegheny river, to the southern margin of Butler county, when it turns abruptly to the west, and passing along the line between this county and Allegheny, forms the divide between the waters flowing north-west into the Connoquenessing, and those flowing south-east and south into the Allegheny and Ohio rivers.

It continues in a westerly direction to near the western line of Allegheny county, when it is deflected to the south-east by the valley of Brush creek; but passing it, around the heads of the two Sewicklies, it takes a north-west direction through Beaver county, and finally terminates in a narrow high tongue of land between the Big Beaver and Connoquenessing, near the mouth of the latter stream.

The other water-shed extends north and south through the western part of Beaver county, and forms the divide between the waters of the Big and Little Beavers

Rivers —The Allegheny river flows along the eastern margin of the district, from Freeport to Pittsburg. The following are its principal tributaries, commencing at the north:

Big Buffalo rises in the north-eastern part of the district, and flowing south along the margin of Butler county drains all that portion of it east from the divide, and receiving from the west Long, Rough, and Cornplanter runs, and Little Buffalo, it empties into the Alleghany at Freeport It carries a large amount of water, and is a bold and rapid stream The channels of its tributaries are mere gorges cut down through the Buffalo and Mahoning Sandstones, which rise in vertical cliffs along their sides. The Butler branch of the West Pennsylvania railroad passes up Little Buffalo

Big and Little Bull creeks, are the next to the south which rise in the southern portion of Butler, flow south through Allegheny, and, uniting one mile above Tarentum, empty into the river at that point

Big and Little Deer creeks, in a similar manner, rise in the northern part of Allegheny, and, flowing south-east, rudely parallel to each other, unite two miles from the Allegheny river, and empty into it at Harmerville

Pine creek comes next on the south, and is the largest stream in this portion of the county. It heads in several branches in the north-west part of Allegheny, and, flowing in a south-east course, receives numerous tributaries, and enters the Allegheny a short distance below Sharpsburg Its sides are very steep and rough, and covered in many places with a dense growth of pine trees, whence its name.

Girtie's run and Butcher's run are the remaining streams which enter the Allegheny south of Pine creek Both are small, and the latter is the one on which occurred the disastrous flood at Allegheny City, in 1874, when two hundred persons were drowned.

The Ohio river forms the entire southern boundary of the district From Pittsburg to the mouth of the Big Beaver its general course is north-west; but there it turns abruptly to the south-west, and continues in that general direction to the Ohio State line.

Wood's, Jack's, Lowrie's, and Killbuck runs, and Little Sewickley creek are the principal streams entering the Ohio in Allegheny county. They are all comparatively small, and drain only a limited area. Their descent is very rapid, however, and they are subject to sudden floods.

Big Sewickley creek forms most of the boundary between Allegheny and northern Beaver. It is a rapid stream, and drains a considerable area in both counties

Legionville, Tivebaugh, Crow's, and Dutchman's runs, all rising in Beaver county, flow south with a rapid fall.

Big Beaver River enters Beaver county nearly in the center of its northern line, flows nearly due south, divides northern Beaver into two nearly equal portions, and empties into the Ohio at Rochester. It cuts far down into the massive conglomerate sandstones which lie at the base of the Lower Productive Coal series ; and their outcrops, rising in immense perpendicular cliffs along its banks, render its course very wild and picturesque. Near the Paper-mill above Beaver Falls, the river leaves its ancient channel and meanders about in the top member of the Conglomerate which here forms the bed for more than three miles, and causes the rapid fall in the stream which affords Beaver Falls and New Brighton their unrivaled facilities for water-power The descent of the Beaver is twenty feet to the mile until the Conglomerate has passed below its bed.

The tributaries of the Beaver within the county are all small streams, except Brady's run which enters it from the west below New Brighton But just north from the Beaver county line the Connoquenessing empties into it.

Connoquenessing Creek drains nearly all the southern half of Butler county, as well as portions of Allegheny and Beaver. It takes its rise in the Eastern part of central Butler in several branches, which unite near Butler town to form the main stream. The general course from this point is a little south of west, though it makes many large sweeps both to the south and to the north. All of its important tributaries, with one exception, enter it from the south. These are in descending order.—

Thorn, Glade, Breakneck, and Brush creeks, which all head up in the divide against the streams which flow south-east into the Allegheny and Ohio. Their courses are uniformly to the north-west, or directly opposite to those of Pine, Deer, and Bull creeks which rise on the other side of the water-shed

Little Connoquenessing puts into the main stream from the north-east a short distance above Harmony. It also drains a large area, and flows almost parallel to the Big creek for several miles, being separated from it in many places by only a high narrow ridge

The country along the Connoquenessing from Butler to within a few miles of Harmony is a perfect wilderness, and the channel of the stream, a deep and narrow gorge. This is due entirely to the great Buffalo Sandstone, which spreads in one unbroken sheet of conglomerate all over this area. It comes at an elevation of 150—200 feet above the stream, and caps the steep bluffs in long lines of cliffs, while its debris and huge fragments cover the slopes below The same state of affairs occurs on the Little Connoquenessing, and the country along it is even more of a wilderness than that on the Big creek. The fall of the Connoquenessing from Butler to near the northern margin of Beaver county, is only about six feet to the mile, but there at Hazen's bridge it cuts down to the Conglomerate, and entering it the descent is rapidly increased to twenty-five feet per mile, which it retains until meeting the Slippery Rock, and is even then very little decreased throughout the rest of its course down to the Big Beaver The scenery along the Connoquenessing after it begins to cut into the Conglomerate is wild and grand. Its channel is a miniature cañon with vertical cliffs of massive sandstone rising 100 feet above its bed. This is a noted resort for excursion parties during the summer.

All the tributaries entering the Ohio below the mouth of the Big Beaver are small and insignificant streams, until we approach the State line, where the Little Beaver comes into it from the north, having its mouth in Pennsylvania but soon passing into Ohio as we ascend it. This stream drains a large area, and carries off the water from the western part of Beaver county, by means of the North Fork and other smaller streams.

The Pennsylvania, or North Fork of Little Beaver, is a comparatively sluggish stream; but at Fredericktown, Ohio, where it joins the main stream, the axis which crosses there brings up the massive sandstone at the base of the coal measures, and the stream, cutting down into it, falls at the rate of 25 feet per mile from this point to its mouth From Fredericktown to near its mouth it flows along the edge of the State, two to three miles west from the line.

The soils of the district are largely derived from the decomposition of the Barren Measure shales and sandstones, and as these measures contain a comparatively small quantity of lime, we of course find only two classes of soils resulting, viz: stiff clays and light sandy soils. The two are often intermingled and pass from one into the other through all shades of gradation. The rich black loams, so common in Washington and Greene Counties, are almost unknown in this district.

In the portion of Allegheny with which we have to do, the soils are derived exclusively from the Barren Measure rocks, except along the river terraces. Hence they are never naturally rich, yet with proper attention to fertilizing can be made very productive.

The red clays which universally accompany the Barren Measure series in this portion of the coal field, become in many cases a regular nuisance to the farmers; for it seems that no amount of cultivation can render them fertile, while they form a soil so stiff and tenacious that the plough can only with the greatest difficulty be drawn through it The largest and most persistent of these red clay bands comes about the middle of the series; and in the northern portion of Allegheny, where the highlands are somewhat level, this stratum makes the surface rock over a considerable area, and whole farms are sometimes rendered comparatively sterile by its presence.

In Butler county also nearly all the arable soils are derived from the Barren Measure rocks; for although the streams cut down into the lower coals, yet the hill sides are so steep and rugged that their cultivation is rarely attempted, and consequently all the farming lands, with few exceptions, lie back from the streams on the high lands composed of Barren Measures. From this it results that a large portion of the county has a poor soil, and requires constant fertilization to render it a productive farming country.

The best farming lands of Butler are in the vicinity of Harmony and Zelienople, where the Connoquenessing has carved a broad and beautiful valley out of the Lower Coal Measures, and the soil thus derived is very rich and strong.

Likewise in Beaver county the Barren Measures are the source of by far the larger portion of the soils; since here, as in Butler, the hill-slopes bordering the streams are so steep and rough that they are seldom cultivated, and all the farming lands come high up on the hills which are covered with these Barren Measure rocks.

The only exception to this is the valley of the North Fork of the Little Beaver, which is occupied by the Lower Coal Measures, and has a very fair soil.

From what has been said of the derivation of the soils in this district, it will be seen that the farmers have very little in their favor with which to begin, and hence the use of fertilizers is necessary to secure a paying crop. But while the great majority have learned that it pays to enrich the soil with common manure, yet the farmers, with very few exceptions, appear to be in comparative ignorance of the beneficial effects of the use of lime.

The Lower Barren Measures, from which, as we have seen, nearly all the soils of the district are derived, contain very little limestone, and hence the small amount of calcareous matter originally in the soil has nearly all been used up by the annual extraction of crops, so that the land is literally famishing for lime. There are very few farms on which lime sufficient for all agricultural purposes cannot be obtained, yet there are scarcely a dozen farmers in the district who make a regular and systematic use of it, notwithstanding the fact that its application would frequently increase the production an hundred fold. This apparent indifference of the farmers to their own interests can be accounted for in two ways. A large proportion of them are unaware that the application of lime would particularly benefit their land or increase their crops, and the other portion do not know that there is any limestone on their lands. I have frequently seen the Crinoidal Limestone in immense piles along the fence rows, whither it had been hauled from the fields as a cumberer of the ground, the owner of the land never once suspecting it to be a limestone.

This district however can never be a famous farming region, because the soil can be more profitably employed in grazing. Many of the Beaver county farmers are beginning to appreciate the fact, and of late years have turned their attention more to stock-raising and wool-growing. Hay is also grown to a considerable extent by many of the farmers of Northern Allegheny and Southern Butler.

Along the Ohio river and in the vicinity of Allegheny city, gardening is profitably pursued, since a ready market for every description of vegetables can always be found at Pittsburg.

CHAPTER II.

Surface Geology; Drift; Terraces; and Ancient and Buried River Channels.

1. *The Drift.*—The valleys of the Ohio and the two Beavers are now filled with Glacial Drift, similar in many respects to that which spreads in an unbroken sheet over northern Ohio and north-western Pennsylvania.

No direct evidence can be found, however, that any of the great ice streams of the Glacial Period ever extended so far south as the Ohio river, within the limits of this district. It is, therefore, very probable that the great beds of metamorphic boulders and cobble stones, which now occupy the valleys of these streams, and extend in many cases two or three hundred feet above their present beds, owe their transportation hither to the streams themselves, which have carried them down, during floods and freshets, from more northern localities where these streams and their tributaries cut through the true Glacial Drift.

What makes this more probable is that the boulders themselves are all rounded and water-worn, while the blue clay which forms their matrix so to speak in the true Drift, further north, is here never seen, but its place is occupied by coarse river sand and gravel, which fill up the spaces between the cobble stones.

This transported material is very conspicuous at the mouth of the Big Beaver, where it is seen in the steep bluffs along the railroad. It has there been quarried away extensively for ballast. At this point it appears in a perpendicular cliff, as the whole mass has been cemented by the percolation through it of water charged with lime and iron. The weathering of the bluff gives the material a kind of stratified appearance, and many of the cobble stones cohere so firmly that they cannot be dislodged without fracture. They vary from one to six inches in diameter, and consist of granite, gneiss, greenstone, quartzite, sandstone, conglomerate, limestone, &c.

2. *Erratics.*—There is one class of rocks, however, which we find scattered over the surface of north-western Beaver county that do not owe their transportation southward to the streams, nor have they any connection with the Glacial Drift proper These erratic blocks of granite are confined to the valley of the Big Beaver, and that portion of Beaver county west from it They have never been seen within the district east of it, nor south of the Ohio river in Pennsylvania. They are found lying on the surface in the valleys, on the hill sides, and on the summits of the highest hills. Along the Big Beaver hills, in the northern part of the county, they were seen 1,300 feet above tide, and none rise too high for them, although from some high knobs they have been hauled off by the farmers, and one unacquainted with the fact might be led to suppose that the knobs in question passed above their limit They are of all sizes, ranging from six inches in diameter up to several feet. One was seen in Darlington township ten feet long, eight feet across and six feet high. In many places they are scattered so thickly as to almost cover the surface, as is the case on the high ground in the borough of Beaver Falls.

Dr. Newberry accounts for the presence of similar isolated rocks in Ohio, by supposing that during the most recent submergence of the continent they were transported by icebergs, which, breaking away from the Canadian highlands, gradually melted as they passed into the warmer waters of the south, and dropped their imbedded crystalline rocks upon the surface where we find them.

This is in all probability the true theory of their transportation, and yet there is a confessed difficulty in understanding why their southward limit should be so sharply defined at the Ohio river; for none pass across it into southern Beaver, as I have been over every township in it, always on the lookout for them, but seeing none.

3. *Terraces.*—Along the Ohio and Big Beaver, are some very handsome terraces. Those facing the Big Beaver are continuous with those facing the Ohio. The principal ones come at the following elevations above the rivers :

Fifth terrace, ...	280 to 300 feet.
Fourth terrace, ...	200 to 220 "
Third terrace, ...	120 to 130 "
Second terrace, ...	60 to 80 "
First terrace, ...	30 to 40 "

The first terrace constitutes the flood plain of the river, and is constantly present. All the islands in the Ohio river are remnants of this one. Where exposed along the river banks, it is seen to consist of coarse sand and silt, together with some gravel, and an occasional boulder. It is probable, however, that these exposures do not properly represent the true constitution of this terrace, since its material is being constantly rehandled at every flood.

The second terrace is also quite persistent along the Ohio and Big Beaver, and furnishes sites for many of the towns.

In the vicinity of Sewickley it has a very wide expanse, and forms the beautiful site for that town. Phillipsburg, opposite the mouth of the Big Beaver, is situated on it; and the larger portions of New Brighton and Beaver Falls are built on the same. The structure is finely exposed at Rochester, where it has been extensively dug away for ballast for the railroad. It is seen to be a perfect mass of rounded and polished cobble stones, commingled with coarse sand and gravel. The most of the boulders are of metamorphic rock, and, as previously stated, have been derived from the Drift.

The third terrace is also persistent along both rivers, and many towns are likewise situated on it Among these are Economy, Beaver, Georgetown, and the upper portions of Rochester, New Brighton, and Beaver Falls

The structure of this terrace is the same as the one below it, except that the rock material is coarser, the rounded and polished boulders being somewhat larger. Along the Beaver, and below its mouth along the Ohio, this terrace is a mere boulder bed, but as we pass above it the crystalline rocks cease, and we go up over a rocky escarpment to the

Fourth terrace, which has been extensively eroded, and is now seen in only a few localities. It is quite prominent along the Big Beaver, however, and near its top supports a deposit of yellowish-white, greasy, aluminous clay.

The fifth terrace is seen a few miles below Pittsburg, and the upper part of Bellevue is built on it Small crystalline gravel is seen near its top. This terrace is also seen along the hill back from Economy, and at the mouth of Big Beaver, although no metamorphic rocks are found in connection with it there.

At New Brighton the succession of the terraces is seen better than at any other locality, and we find them at the following elevations above the Big Beaver:

Fourth terrace, ...	215′
Third terrace, ...	125′
Second terrace, ...	80′
First terrace, ...	30′

The first terrace is quite narrow, and is a mere shelf along the bed of the Beaver.

The second terrace is quite extensive, and the larger portion of the town is located on it This is the one along which the railroad passes through the town. It is a perfect mass of rounded and polished metamorphic rocks.

On *the third terrace* the upper portion of the town is built, and it also covers a considerable area. The structure is well exposed in cuttings along the streets which pass from the second terrace up on to the third.

The fourth terrace is that on which "Kenwood" stands. It is also seen at the brick-yard on the hill above the Terracotta works of Elverson & Sherwood.

A section of these terraces, from the top of the fourth down to the river, is as follows:—

1. Sand mixed with clay and an occasional boulder of rounded sandstone, ...	6′ to 10′
2. Greasy, aluminous clay, creamy white in color and used at the Terra-cotta works for the manufacture of plant pots, ...	5′ to 8′
3. Rocky escarpment covered with debris down to the level of third terrace, ...	75′

4. Rounded and polished boulders of granite, gneiss, conglomerate, sandstone, limestone, &c., varying in size from one to ten inches in diameter and lying in immediate contact, with sand and small pebbles filling up the inter-spaces, down through third, second, and first terraces to the river, 125′

Terrace clay.—The fourth terrace extends up the Beaver for a long distance and is still covered with the creamy clay which is seen at New Brighton.

Where the Pittsburg, Fort Wayne and Chicago railroad crosses Wallace's run, three miles above Beaver Falls, this clay is seen in the top of the cut, and a sample of it from that locality gave by analysis of Prof. Wuth of Pittsburg: Water 9.80, Silica 51.34, Alumina 33.50, Lime 1.85, Alkalies 1.11, Magnesia 70, Iron 78.

This deposit was evidently accumulated at the bottom of one of the ancient lakes which overspread this region, and it probably marks the upper limit to which the valleys of the Beaver and Ohio were filled with silt during the Champlain Period

It cannot be certainly known however that the old valleys were refilled to a higher level than the top of the third terrace, for here the metamorphic boulders apparently cease, and a rocky escarpment leads up to the fourth terrace at every point where the fourth is seen.

Not so with the escarpments of the second and third terraces; for these, although they are quite steep, are cut down through the boulder bed itself, and at New Brighton a well commencing on the top of the third terrace would pass through nothing but this deposit down to the level of the Big Beaver.

At Beaver, several wells commencing at the top of the third terrace have been sunk down to the level of the Ohio, but no solid rock was found in any of them.

Terrace lines are also seen along some of the tributaries of the Big Beaver and Ohio.

On the Connoquenessing at Harmony some very broad handsome terraces occur at 20, 60, and 110 feet above the stream. They cannot be traced for any distance along it, because the valley narrows very much both above and below this point and they have been cut away by erosion

In the valley of the Little Beaver terraces are also frequently seen, but they have suffered much from erosion, and no general system can be made out.

Gravel Bed —One mile east from New Gallilee along the Pittsburg, F. W and Chicago R. R. occurs what is locally known as the "gravel bed" It has long been dug for ballast, and is well exposed at the side of the railroad It is there 60 feet thick and is seen to consist of rounded boulders of granite, limestone, sandstone, &c , *together with fragments of coal,* and much coarse sand filling up the intervals between the boulders, and also occurring in irregular, lenticular masses by itself. This is a remnant of one of the terraces along the little Beaver, and its top comes 130 feet above the bed of the creek at this point, showing that the valley of this stream was silted up to the same level as those of the Ohio and Big Beaver, since this corresponds to the third terrace along the latter streams

4 Buried River Channels.—The Ohio river flows around this district on a bed of boulders and detritus which extends to an unknown depth, as no explorations have ever reached its bottom. The piers of the railroad bridge across the Big Beaver river near its mouth, are built in an old channel of the Ohio river, and no rock foundation could be found for them at a depth of sixty feet below its present surface No data have yet been obtained which can settle definitely the depth to which this buried channel extends, but from what is known of the ancient bed of the Big Beaver the Ohio must once have flowed considerably more than 100 feet below its present level, and possibly more than 200 feet below it. At least this is true of that portion of it below the mouth of the Big Beaver.

To one carelessly passing up the Big Beaver it would seem as if this stream could never have flowed at a lower level than it does now; for in the vicinity of New Brighton and Beaver Falls a massive sandstone is seen stretching across its bed, from bank to bank, in such a manner that there would appear to be no place for a buried channel This, in view of known facts, was quite puzzling to myself until I had obtained the data which put me on the track of its ancient bed.

I discovered that about seven miles above its mouth the stream leaves its ancient channel far to the right and enters it again at only a short distance from the Ohio river Between New Brighton and Beaver Falls the present open channel passes almost at a right angle across the ancient buried one.

The old channel was much straighter than the present one, and as traced out by means of wells, borings and other explorations, it passes approximately along the following line: It leaves the present channel two miles above Beaver Falls, a short distance above the paper-mill, and keeping to the right passes down through the borough along the present valley of Walnut Bottom run The Beaver Falls Cutlery-works are situated near its center. Passing out of Beaver Falls it crosses the present channel of the Beaver a short distance above the railroad bridge, and goes down through New Brighton near the center of the second terrace, and coming over close to the present channel enters it at the lower end of the town near the mouth of Block House run. From this point the two channels coincide for some distance; but about one mile above the mouth of the Beaver the old channel again veers off to the right through Bridgewater and Beaver and passes into the Ohio somewhere between Vanport and Beaver Station.

To what depth this old river bed extends, has never been determined. We know, however, that it was more than 100 feet deeper than the present bed of the Beaver; for in building the cutlery-works no rock foundation could be found at a reasonable depth, and to test the matter an iron rod was driven down which still found no rock at a depth of 100 feet below the level of the Beaver.

In this same old channel, a short distance south-west from the paper-mill, Mr. Ramsey informed me that from the bottom of a well 35 feet deep he drove a pipe 50 feet through quicksand and gravel without coming to any rock.

At the woolen-mills, in New Brighton, this old channel seems to pass along the very edge of the present one; for, Mr. Coale informs me, that here, on the left bank of the Beaver, he drove a pipe fifty feet below its level without finding any solid rock. It is very probable that in Beaver county this filled-up channel extends down 200 feet below present channel of the Beaver; for, according to Dr. Newberry, the oil wells bored at the junction of the Mahoning and Shenango found no rock for 150 feet below their present beds.

5. *The Probable Agent of Erosion.*—To what agent shall we ascribe the erosion of these now deeply buried channels along the Big Beaver and Ohio?

I have spoken of them as though the work had been done by the rivers themselves during a period of continental elevation, since this is the commonly accepted theory. But a class of facts were observed in this district for which the above theory fails satisfactorily to account.

It was observed that all the tributaries, both large and small, which enter the Big Beaver and Ohio within this district are now flowing over rock bottoms within a few rods of their mouths. Thus—

A short distance above the mouth of the Little Beaver a massive sandstone is seen stretching clear across its bed, while a rocky escarpment, rising on each side to the summit of the hills, absolutely precludes the possibility of a buried channel Of course it is incredible that a stream carrying so much water as the Little Beaver could have flowed to within a few rods of the Ohio on a bed 200 feet above that of the latter stream.

At the mouth of Raccoon creek, which is a large stream entering the Ohio from the south, there is a rock bottom, with vertical cliffs rising on each side; so that there no buried channel can exist.

The Connoquenessing, which enters the Big Beaver near the northern line of the district, we see flowing on a rocky bed only one fourth of a mile above its mouth, where it is hemmed in by cañon-like walls of the Conglomerate, which rise from the bed of the stream, and likewise exclude all possibility of a buried channel

Numberless smaller streams, but many of which are of considerable size, tell the same story. It is simply inconceivable that all these tributaries could ever have emptied into rivers which were flowing 200 feet beneath their mouths, without at the same time cutting down their own channels to nearly the same level. The topography along these rivers also shows that their tributaries could never have occupied any other channels than those in which they are now flowing.

We must then accept one of two conclusions; either that the drainage lines which are now occupied by these tributaries had no existence during the long period in which the Big Beaver and the Ohio were excavating their now deeply buried channels, or else that this excavation was not done by water, but by streams of ice which came down these valleys from the north during the Glacial Period, grinding down and ploughing up their channels far deeper than the rivers themselves ever flowed.

The reader can take whichever horn of the dilemma he prefers.

[The above clear and succinct statement of the interesting phenomenon of a system of ancient river valleys, now filled up with water-rolled materials to a level with the present surface of the country, in the district of Western Pennsylvania surveyed by Mr. White, will be supplemented by Mr. Carll's descriptions of the buried valleys of Warren, Crawford, and Venango counties, in his forthcoming Report of Progress I.I.I.

Other facts, serving to enlarge our view of the case, and to connect the observations on ancient erosion in Western Pennsylvania, with those which have been made in late years by Dr. Newberry in Ohio and Kentucky, will be published in Mr. White's Report on Lawrence county.

It is not yet certain that we are shut up to the acceptance of one or other of only two conclusions. The problem is quasi-continental in its breadth, and the collection of facts is a slow process, and still very incomplete.

Perhaps the most instructive and important aspect of the subject is that which involves the consideration of still more ancient erosions, and brings together before the eye of the geologist the buried river valleys of the Carboniferous Era, with those of the comparatively modern Champlain age.

Its bearing upon the shape, course, and materials of the Oil Sand channels lends additional importance to the subject, and demands its most cautious and judicious treatment.—J. P. L.]

CHAPTER III.

The Anticlinals of the District.

The rocks exposed in this district extend from the Pittsburg coal far down into the Conglomerate Series, thus giving a full view of the Lower Barren Series, the Lower Productive Coals, and about 200 feet of the massive conglomerate sandstones which lie at their base.

The Pittsburg coal is confined to the summits of a few very high knobs in north Allegheny, and there are never more than 50 feet of measures above it.

The Lower Barren Series covers nearly the entire surface of north Allegheny, and all the highlands of South Butler and Beaver.

The Lower Productive Coal Series occupies the escarpments of all the larger streams in South Butler, and extends far up on the hills along all the streams of Beaver county. Only the upper part of this series is brought to the surface in Allegheny county, and that over but a small area, along the upper portion of the Allegheny river, and along the line of the Fifth or Brady's Bend axis.

The Conglomerate Series is seen only in Beaver county, along the Big Beaver river and Connoquenessing creek.

1. The Anticlinal of Brady's Bend passes through the south-eastern portion of this district. Its axis enters Butler county in the south-eastern portion of Clearfield township, and crossing Long run near this point brings up the Ferriferous Limestone. Continuing its course south 40° west it crosses Rough run one half mile below Denny's mill, and there brings up the top of the Conglomerate

It crosses Little Buffalo near Saxon city, and passing through the north-western corner of Buffalo township enters Clinton near the head of Sarver's run, where it brings the Upper Freeport coal to the surface. Passing on through Clinton township, it crosses the head waters of Big Bull creek near Lardintown and Pughtown, where it also exposes the Upper Freeport coal.

Entering Allegheny county in West Deer township, it passes west of Culmersville, and crosses Big Deer creek just above Martin's coal-works, where the Upper Freeport coal is just brought to the surface in the bed of the creek

Passing through Hampton township it crosses Pine creek near the mouth of Gourd-head run, bringing the Upper Freeport coal 50 feet above the stream, and keeping it exposed for three miles along the same.

Girtie's run is crossed at the forks of the stream, above Evergreen, and the Axis reaches the Ohio river at the mouth of Wood's run, three miles below Pittsburg This is very probably the *Washington Axis* of Professor Stevenson's Report of Progress K, in Washington county.

The south-east slope of this Anticlinal of Brady's Bend is very sharp, and near its crest it is frequently seen with a dip of 3°.

The north-west slope is also quite rapid for a short distance, but it soon flattens, and the trough west from the Axis is very shallow.

The decline of the anticlinal axis to the south-west is very rapid. By comparing levels where it crosses the Butler branch of the West Pennsylvania road on Little Buffalo creek, and where it crosses the Pittsburg, Fort Wayne, and Chicago railroad at Wood's run, we find its rate of flattening very nicely. Taking the Upper Freeport Coal as a horizon, we find its altitude at the crest of the Axis on Little Buffalo, near Saxon city, 1,175 feet above tide, and at Wood's run where the Axis crosses the Ohio river the same coal is about 100 feet below the railroad track, or 630 feet above tide, thus giving us *a southward slope along the crest of the Axis* of 545 feet in this distance which in a straight line is not far from 25 miles.

This makes a decline of 22 feet per mile along a line running about south 40° west.

At Wood's run the Anticlinal is still quite marked, and it makes a hoist in the rocks of 160 feet between that point and Pittsburg.

2 *Anticlinal on Bull's creek.*—Although the Brady's Bend anticlinal is the only axis within the district which can be definitely traced, other minor ones exist.

3. The crest of a very sharp one is seen crossing Bull creek, about four miles south-east from this one.

4. *Anticlinal on Beaver River.*—Passing west from the Brady's Bend Anticlinal along the Ohio, there is at first a sharp dip for a short distance, and then the rocks are almost horizontal for about seven miles, when they again commence rising to the north-west, and continue rising in that direction at about the rate of 20 feet per mile, until we have ascended the Beaver River nearly to the Lawrence county line. Here another quite well marked Axis is seen crossing the Connoquenessing, three fourths of a mile below Hazen's bridge, near the Beaver county line; and crossing the Big Beaver about half way between Clinton and Homewood, and the Little Beaver, at Fredericktown, in Ohio.

North-west of its crest the strata dip for only a short distance, when they become horizontal again for a few miles, and then recommence rising to the north.

DESCRIPTION OF THE FORMATIONS.

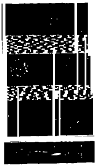
CHAPTER IV.

The Upper Productive Coal Series.

Pittsburg Coal Bed.—The only representative of this system found within the district is the Pittsburg coal. It occurs in a few outlying patches in Allegheny county, in the summits of some of the highest hills, and its whole area is not more than 250 acres, of which by far the greater portion has already been taken out.

The coal exhibits a structure very similar to that of the same bed along the Monongahela river, as will be seen by the following section (Fig. 1,) from Mr. Wright's bank, in Franklin township:

1.	*Coal,*	2′ 6″	Roof coal	6′ 6″	12′ 6″
2	Shale,	1′ 6″			
3.	*Coal,*	2′ 6″			
4	Shale,			1′ 2″	
5.	*Coal,*	2′ 9″	Main bench	4′ 10″	
6.	Shale,	½″			
7.	*Coal,*	4″			
8.	Slate,	½″			
9.	*Coal,*	1′ 8″			



The roof coals are here enormously developed, but both are slaty and are never mined

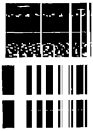
There are only about 30 feet of rock above the coal here, and of course it has deteriorated very much from long exposure so near the surface.

The only rock ever seen in place above the coal is the *Pittsburg Sandstone* which caps some of the knobs and is very massive.

The most northern locality at which this coal occurs is in Pine township, four miles south from the Butler line. Here a high knob towers 100 feet above any of the surrounding hills, and catches about three acres of this coal in its summit, several miles from any other locality of its out-crop

It is mined there by Mr Emmitt, and the section is interesting from the number of slate partings which it shows. It is as follows: (Fig. 2)

1.	Slaty coal,	1′ 0″	Roof,	3′ 3″	10′
2.	Shale,	4″			
3.	Coal,	1′ 2″			
4.	Slate,	½″			
5.	Coal,	9″			
6.	Shale,			1′ 4″	
7.	Coal,	6″	Main bench,	5′ 5″	
8.	Slate,	1″			
9.	Coal,	2′ 4″			
10.	Slate,	½″			
11.	Coal,	4″			
12.	Slate,	½″			
13.	Coal,	9″			
14.	Slate,	¼″			
15.	Coal,	1′ 4″			



From these isolated patches of coal we learn that the great Pittsburg bed once extended all over north Allegheny, and probably over the entire district.

CHAPTER V.

The Lower Barren Measure Series.

In this series I have included all the strata from the Pittsburg coal down to the Upper Freeport. This seems a much more satisfactory arrangement than to limit the Barren Measures by the Mahoning Sandstone, for that rock is such a variable quantity that half the time it cannot be distinguished from the rest of the Barren measures above it, and in such cases one never knows where to place the limit between the two. But by extending the Barrens down to the Upper Freeport coal, we always have a definite horizon from which to reckon, and one which we can never mistake.

As previously stated, the Barren Measures are seen in their fullest development only in Allegheny, though their lower half spreads over Beaver and Butler.

General Section in Allegheny County.—The generalized section on page plate 1, fig. 3, shows these measures as developed in Allegheny county; and with slight alterations it will answer for the same series as seen in Beaver, although the highest rock there exposed is the Morgantown Sandstone. The section is also typical of the Barrens in south-western Butler. (For the text see page 24.)

General Section in Butler County.—In the eastern portion of Butler county, and along through the central portion of the area, we find a somewhat different series, which is typified by the following section, taken at Freeport. See Page plate 1, fig. 4. The upper 40 feet of this section is not seen at Freeport, but is merely added to complete the section up to the Crinoidal Limestone. (See page 24.)

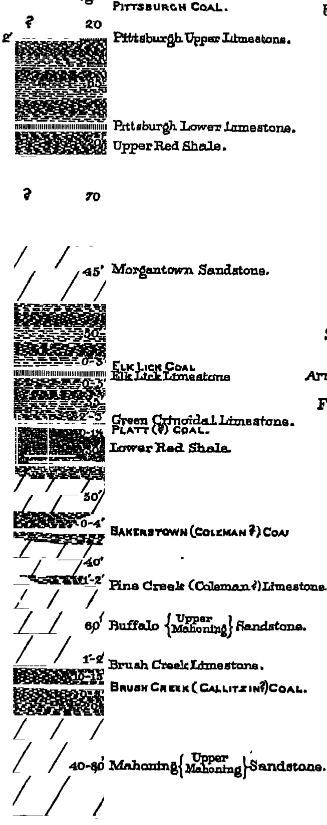
General Section of the Barren Measures in Allegheny County, Pa. See Fig. 3.

		FEET.
Pittsburg Coal.		
1. Interval of measures, mostly concealed from view,		20
2. *Upper Pittsburg Limestone,*		2
3. *Variegated Shales,*		65
Little Pittsburg Coal (wanting).		
4. *Lower Pittsburg Limestone.*		5
5. *Upper Barren Measure Red Shale,*		20
6. Interval concealed from view,		70
7. *Morgantown Sandstone,*		45
Local small Coal Bed.		
8. Variegated Shales,		50
9. *Elk Lick Coal,*		0 to 3
10. *Elk Lick Limestone,* dark,	Berlin Group.	0 to 5
11. Variegated Shales,		35
Berlin Coal (wanting?)		
12. *Green Crinoidal (Berlin) Limestone,*		2 to 3
13 *Platt (?) Coal,*		0 to 1½
14. *Lower Barren Red Clay Shale,*		30
Price Coal (wanting?).		
15 Sandy Shales and Shaly Sandstone,		50
16. *Bakerstown (Coleman?) Coal,*		0 to 4
17. Shales and Sandstone interval,		40
18. *Pine Creek (Coleman?) Limestone,*		2
19. *Buffalo, or (Upper Mahoning) Sandstone,*		60
20. *Brush Creek (Philson?)* Limestone,		1 to 2
21. Dark Shale interval,		10 to 15
22. *Brush Creek (Gallitzin?) Coal,*		0 to 3
Local Limestone (4′ to 6′).		
23. Shale interval,		20
24. *Mahoning (Lower Mahoning) Sandstone,*		40 to 80
Total height of Section, 600′, mean of		570 to 630

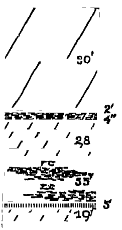
General Section of the Barren Measures at Freeport, in Armstrong County, Pa. See Fig. 4.

		FEET.
(12.)	1. *Green Crinoidal (Berlin) Limestone,*	3
(14)	2. *Lower Barren Red Clay Shales,*	30
(15)	3. Grey Sandy Shales,	100
(16.)	4. *Bakerstown (Coleman?) Coal,*	1
(18)	5. *Pine Creek (Coleman?) Limestone,*	1
	6 Concealed interval,	10
(19.)	7. Buffalo (U. Mah.) conglomeratic Sandstone,	50
(21)	8. Sandy Shales,	35
(22)	9 *Brush Creek (Gallitzin) Coal* (Blossom).	
(23.)	10 Sandy Shales,	35
(24.)	11. Mahoning (L. Mah.) Sandstone,	55
	Total height of Section,	320

Generalized
Section of Allegheny Co Coal Measures
Fig. 3.

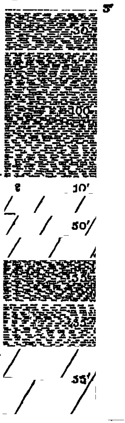

Pittsburgh Coal.
? 20
2'
Pittsburgh Upper Limestone.
65
Pittsburgh Lower Limestone.
20
Upper Red Shale.
? 70
45' Morgantown Sandstone.
30
0-3'
Elk Lick Coal
Elk Lick Limestone
0-3'
25
2-5
Green Crinoidal Limestone.
Platt (?) Coal.
0-1½
20
Lower Red Shale.
30'
0-4'
Bakerstown (Coleman ?) Coal
40'
1'-2' Pine Creek (Coleman?) Limestone.
60' Buffalo {Upper Mahoning} Sandstone.
1-2' Brush Creek Limestone.
0-1½
Brush Creek (Gallitzin?) Coal.
0-4'
20
40-80' Mahoning {Upper Mahoning} Sandstone.

Section of
Mahoning Sandstone Group
Fig. 6.



Section at
FREEPORT
Armstrong County

Fig 4.



In the description which follows reference is always had to the Allegheny county section, when not otherwise stated.

For 200 feet below the Pittsburg Coal the measures far up on the hills are rarely exposed, and a part of them were not disclosed at any place.

The Upper Pittsburg Limestone, 20 feet below the Pittsburg coal, is seen at several localities as a light gray limestone It is quite compact, breaks with a conchoidal fracture, and its weathered surface is almost snowy white. It has been burned in a few instances, and makes a beautiful white lime.

The Variegated Shales, No 3, are exposed at only one locality, and then are poorly shown along the road. Here, near Mr. Wright's coal bank, in Franklin township, they seem to consist of variegated, sandy, and argillaceous shales; red, brown, and light colors alternating with each other.

The Little Pittsburg coal should come in this interval, but nothing was seen of it.

The Lower Pittsburg Limestone, 87′ below the Pittsburg Coal, is numbered 4 in the General Section.

This is seen at nearly every locality where the Pittsburg coal occurs, as well as near the summits of many hills which are just too low to catch the coal. One of these localities occurs far away in the eastern part of Beaver county, where in Economy township a very high knob is covered near its summit with blocks of this limestone, while the nearest other out-crop of the rock is ten miles off. It is generally found in two or three layers, is tolerably firm, of a dark gray color on fresh fracture, but soon weathers to a dirty yellow, as it contains considerable iron. It has been burned for lime in one or two instances, but does not slack well on account of the impurities which it contains.

The Upper Barren Measure Red Shale.

Coming immediately below the limestone, we have as its constant companion a bed of dull red, argillaceous shales. At times they are variegated and mottled with streaks of buff and greenish yellow marls, but the prevailing color is red. They vary in thickness from 15 to 20 feet and often make a broad band across the roads and fields.

The interval below the red shale is constantly concealed, so that nothing is known of its composition; but from the topography it forms, it very probably consists of soft sandy shales, with possibly a thin bed of limestone.

The Morgantown Sandstone, 182 feet below the Pittsburg Coal, is numbered 7 in the General Section.

This widely persistent member of the Barren Measures is finely exposed in the hills north-west from Allegheny city, where it has been extensively quarried for building purposes. It is a grayish-white rock and is very firm and compact. Some of the layers are quite coarse and almost conglomeratic. It is an excellent building stone.

This is the highest member of the Barren Measures found in Butler county, and is there confined to two townships along the southern margin, where it caps the highest hills. Along the Ohio river it runs out in the tops of the river hills near the mouth of Killbuck, and is there seen in a long line of massive cliffs near the summit of the hill, while immense blocks of it are scattered over the slopes.

There are only two hills in North Beaver which rise high enough to catch this stratum. One of these is the hill previously referred to in Economy township as being covered with blocks of the limestone No 4, and the other is "Big Knob" near the center of New Sewickly township. This latter is the highest point in the district, its elevation being about 1,450 feet above tide. It is visible from a long distance and is quite a curiosity, since, in the very midst of a high range of hills, it rises 300 feet above any of the surrounding ones. It is capped, a few feet below its dome-shaped summit, by this massive sandstone, which doubtless proved its preserver from the wasting erosion that has leveled down everything else so far below.

A small coal bed is seen by its blossom, at one place, immediately under the Morgantown Sandstone at 227′, and at the top of the Varigated Shales, No. 8, next to be described.

The Variegated Shale, No. 8, lies 227′ below the Pittsburg Coal in the General Section.

This is exposed at only a few localities in the vicinity of Allegheny city, and along the beds of Butcher's and Spring Garden runs. It is there seen to consist of variegated, sandy and clayey shales, red, drab, brown, &c.

The Elk Lick Coal bed, 277′ below the Pittsburg Coal, is numbered 9 in the General Section.

This name, which has for a long time been made to do service in designating in turn nearly every coal in the lower half of the Barren Measures, has at last been definitely located by Mr. Franklin Platt, who finds that the true place of the *Elk Lick Coal* is about 30 to 40 feet above the *Crinoidal limestone.** In this district a somewhat persistent coal is found at that horizon, and we have accordingly identified it with the Elk Lick. This coal like all the rest in the Barren Measure series is not at all persistent and is subject to great variations. However, it is frequently seen in Allegheny county, although it has seldom been mined. Near the line between Franklin and Sewickly townships it is now mined by Mr. Aikin, at the head of one branch of Duff's run, where it shows the following structure:

1. Cannel,	8″	2′ 9″
2 Slate,	1″	
3. *Coal*,	2′	

The upper portion is an impure *cannel* and in some parts of the bank is pure enough to burn. The bottom part No. 3 is a hard, brilliant, columnar coal, and is highly prized as a domestic fuel, though it contains rather too much sulphur for smithing purposes. In the vicinity of Allegheny City this coal is represented by a kind of *cannel slate* 1′ to 2′ thick, though at one point on Butchers' run it becomes a bituminous coal and has been stripped out along the run.

Near the head of Pine creek it was once mined on the land of Mrs. Brown, and reported to be two feet thick.

---

* [A historical sketch of the origin and consequences of the early mistakes made in locating this bed properly in the Series of Barren Measures, and the consequences of that mistake affecting the theory of their deposition, may be found in the preface to the Report of Progress on Somerset County HHH, by F. and W. G. Platt. 1876 (1877).—*J. P. L.*]

Near the head of Hite's run, in East Deer township, it has been mined for a long time on the land of Mr. Simon. Here it is 3′ to 3½′ thick, and an excellent coal, on neighboring farms, however, it is not found at all.

In Butler county this coal has been mined at only one locality. At the head of Glade Creek, Mr Hayes once opened it near the top of the hills where it was 2½ feet thick.

In Beaver county it has also been mined at only one locality, and that near the summit of a hill in Economy township, on the land of Mr. Goss, where it was two feet thick.

The Elk Lick Limestone, 280′ below the Pittsburg Coal.

Separated from the Elk Lick coal by from 2 to 4 feet of fire-clay and shales, there is seen in the vicinity of Allegheny city a very dark, fetid, impure limestone, which is also fossiliferous. Between the mouth of Girties' run and and Allegheny city it is finely exposed in cuttings along the West Pennsylvania railroad, where it and the *Crinoidal Limestone* below it are seen in the same section along the steep bluff of the river for a considerable distance. It is seen to be very irregular. At one point it will be a mere calcareous shale, only one to two feet thick, but in a short distance will thicken up and become a limestone 5 to 6 feet thick in irregular shapeless masses. Again, it will suddenly disappear altogether, and as unexpectedly re-appear within a few rods. It is also seen along Butchers' and Spring Garden runs, back from Allegheny city. It is evidently local, as it was seen at but one other locality in the district. It is possible that this stratum may have been identified with the *Crinoidal Limestone* along the Monongahela river, in the vicinity of Pittsburg.

Variegated Shales No 11.—Below this limestone, at 285′ to 320′, around Allegheny city, occurs a bed of sandy and argillaceous shales which are often variegated. The stratum is 30 to 35 feet in thickness, and rests immediately upon the Crinoidal Limestone.

The Berlin Coal which in Somerset county comes next in the series, seems to be wanting in this district.

The Green Crinoidal (Berlin) Limestone, No. 12, lies about 315 feet below the Pittsburg Coal Bed in the Section.

This stratum may be taken as the approximate middle of the Barrens, reckoning them as extending from the Pittsburg coal to the Upper Freeport; for, in this district, we generally find an interval of 300 feet from the Pittsburg coal to the limestone, and 300 more from the limestone to the Upper Freeport. Sometimes these intervals will vary 25 feet in either direction, but for all practical purposes the horizon of this limestone may be taken as the middle of the Barren Measure series.

This rock is the most persistent member of the group. Throughout the entire district in Allegheny, Beaver, and Butler, we never find its horizon exposed without also seeing it. It retains the same lithological features wherever seen, and these are so peculiar that it can always be recognized at a glance. This stratum is aptly described by Prof. Stevenson, in his report on the Greene and Washington district. He says, "it is dark, bluish, or greenish gray, tough, and breaks with a granular surface, much resembling that of a coarse sandstone" It is always crowded with stems of crinoids, and when the rock weathers, these stand out over it in small protuberances, giving it a peculiarly rough and forbidding aspect, which often causes the farmers to consider it anything else than a limestone.

With this rock the section in Butler and Beaver may be said to begin, since it spreads over a considerable area in both counties, while the rocks above it occur only in fragmentary patches.

This limestone is seen 100 feet below the summit of Big Knob in Beaver county, and is there several miles from any other out-crop of the rock. West from the Big Beaver it is caught in the summit of only a single knob.

Besides the usual multitude of crinoidal fragments, the following list was observed in it within the district: *Athyris subtilita*, *Productus Nebrascensis*, *P. semi-reticulatus*, *Spirifer cameratus*, *Nucula ventricosa*, *Bellerophon carbonarius*, *Pleurotomaria Grayvilliensis*, *Astartella concentrica*, and numerous undetermined species.

The Platt (?) *Coal*, 323′ feet below the Pittsburg Coal, is numbered 13 in the General Section.

Coming immediately below the limestone, we often find a thin coal It is generally quite pure, but never attains workable thickness. It has been mined by stripping at one locality on Pine creek, where it is 1½ feet thick. It is frequently absent, and is never of any importance.

The Lower Barren Red Clay Shale, No. 14, lies 325′ to 355′ below the Pittsburg Coal.

Directly below the Crinoidal Limestone, or its underlying coal, when present, comes a bed of dull red argillaceous shales, which appears to be equally persistent with the limestone itself. It is sometimes variegated with yellowish green or buff colored bands, and occasionally contains much iron in nodules. This stratum is often very annoying to farmers in the northern portion of Allegheny, and southern margin of Butler. Here it is the surface rock on the broad and somewhat level highlands. Wherever found, its horizon is marked by a stiff and barren soil, and it frequently spreads over whole farms. It is a conspicuous feature along the roads, which it frequently crosses, in a broad and dark red band, and when wet forms a mortar so stiff and tenacious that locomotion through it becomes almost impossible. It is usually from 25 to 30 feet thick.

The Price Coal Bed of Somerset county should here appear in the section, but does not seem to exist in this particular district, at 355′ below the Pittsburg Coal.

Sandy Shales and shaly sandstone, rarely becoming massive, occupy the next 50 feet of the section, which brings us down the Bakerstown (or Coleman Coal bed of the Somerset county series) underlying the Crinoidal Limestone by an interval of from 75′ to 90′.

The Bakerstown (*Coleman ?*) *Coal Bed*, lies 405′ below the Pittsburg Coal Bed.—This coal has been mined for a long time at Bakerstown, in Richland township, Allegheny county, and is named for that locality. It is very irregular in its deposition, often occurring in one neighborhood on only a single farm. At Bakerstown the coal shows the following structure at Mr. Douglass' bank:

1. *Coal,*	1′ 6″	2′ 8″
2. Slate,	¼″	
3. *Coal,*	4″	
4. Slate,	½″	
5. *Coal,*	8″	
6 Slate,	½″	
7. *Cannel,*	6″	

Here, as will be seen, the bed is considerably broken up by slate partings. The coal itself is rather inferior, but as no other is accessible for several miles, it has been used to some extent by the farmers The *cannel* at the bottom is quite good, and sometimes becomes a foot thick The coal is here 90 feet below the Crinoidal Limestone.

This coal is well developed around the heads of Breakneck and Glade creeks in South Butler. On the land of Mr Park, in Adams township, it is 3′ thick, and a valuable coal. It has never been seen in North Beaver, but in South Beaver the 6′ bed of *cannel* and bituminous coal above Georgetown comes at this horizon (Report K., p 348.)

A Shale and Sandstone Interval of 40 feet comes next in the Section, and is numbered 17 (408′ to 448′.)

A small coal bed here comes in, in the Freeport Section (page plate 1, Fig 4,) resting immediately upon the limestone next to be described, and the blossom of the same coal is frequently seen in Butler county, but it has never been explored, and nothing can be stated as to its thickness.

The Pine Creek (Coleman ?) Limestone, 450′ below the Pittsburg Coal, is No. 18 of the Section.

Over a wide area in the district we find a somewhat persistent limestone at 120 to 140 feet below the Crinoidal, and this we have termed the "Pine Creek," from a locality on that stream, where its relations to the other members of the series were first clearly made known In its lithological character it is quite variable; sometimes it is a compact light dove colored rock, and burns readily into a tolerably fair lime; but more generally it is quite arenaceous, and earthy, and without close inspection would often be very readily mistaken for a stratum of sandstone. It is always fossiliferous, and generally more or less brecciated. In it were seen *Productus longispinus*, *P. Nebrascensis*, *Athyris subtilita*, *Chonetes mesoloba*, *Nautilus occidentalis*, *Orthoceras cribrosum*, and many stems and fragments of *crinoids*

Sometimes the sandy shales overlying it thicken up to a massive sandstone and then the limestone is cut away. This is finely illustrated at Wood's run below Pittsburg. There along the railroad we see a very massive sandstone about 130 feet thick with scarcely a break, but on passing up the stream a short distance, a bed of shale is seen to divide the sandstone mass into two parts, and then we see the Pine creek limestone coming in below the shale at its own proper horizon.

The limestone is seen in a section obtained on the Ohio river, near the State line. It nearly always rests immediately upon the massive sandstone layers below.

The Buffalo (*Upper Mahoning*) *Sandstone*, 450′ to 510′ below the Pittsburg Coal, is No. 19 of the Section.

By this name we have designated a very massive Conglomerate sandstone which comes immediately below the Pine Creek Limestone, and attains its maximum development along the waters of Buffalo creek, in Buffalo township, Butler county. In the section at Freeport it forms the upper bluff rock, and its base is 125 feet above the upper Freeport coal.

From Freeport it stretches in a solid bed of conglomerate through Butler county to near its western margin, keeping well up in the hills above the streams and making a perfect wilderness of the country where it forms the surface rock. The quartz pebbles in it are very numerous and often as large as a hazel nut. Traced south and west from Butler county into Allegheny and Beaver, it loses its conglomeratic character and becomes in many portions of Beaver a mere sandy shale. This is the massive rock seen along the railroad from Allegheny city to Hayesville. A short distance west from the Beaver county line, it again thickens up unto a massive conglomerate along little Beaver Creek in Ohio.

The *Stillwater Sandstone* of the Ohio Reports is probably the same, as the *Buffalo Sandstone* of this district.

This stratum was included in the Mahoning sandstone in the Reports of the First Survey, but as there is a massive sandstone coming below this, to which the term Mahoning has always been applied, it is clear that one or the other should have a distinct name, for the two rocks are always distinct, and never merge into one mass.

At no point in the district is its base less than 90 feet above the Upper Freeport coal, while its top is rarely less than 150 feet above the same.

The Brush Creek (*Philson?*) *Limestone*, 510 feet below the Pittsburg Coal, is No. 20 of the Section.

Coming below the Buffalo sandstone, sometimes immediately, but often separated from it by some intervening shales, we find another widely persistent limestone. It is frequently seen along Brush creek, in Cranberry township, Butler county, and has been designated from that locality. It varies greatly in its appearance. At times it is a black calcareous shale, 4 to 5 feet thick, and again we see it a very compact limestone, 1 to 2 feet thick. It often has a peculiar slaty and arenaceous aspect, and sometimes contains so much iron as to be used as an ore. It is usually fossiliferous, and the following species have been seen in it: *Chonetes mesoloba*, *Spirifer cameratus* *Edmondia Aspenwalensis*, *Bellerophon Montfortianus*, *Productus Prattenanus*, *P longispinus*, *Nautilus occidentalis*, and *Lophophyllum proliferum*

This is the dark calcareous shale and limestone which occurs over what was wrongly called the "Elk Lick coal," in South Beaver, in 1875. It is quite persistent in Allegheny county, as also in Beaver, but is absent over a large area in Butler. In Ohio, Dr. Newberry frequently finds a limestone or calcareous shale above his Coal No. VII, which is in all probability the equivalent of this one. Between this limestone and the coal below there comes a bed of soft, dark shale, which has frequently been explored for *cannel*, but it is too dirty and impure to burn. It is frequently seen in Beaver county making a great black band across the roads.

Dark Shale Interval of 10′ to 15′. No. 21 of Section.

The Brush Creek (*Gallitzin*) *Coal*, 527 feet below the Pittsburg Coal. (Coal No. VII of the Ohio Survey.)

At a distance varying from 10 to 15 feet below the limestone previously described comes a somewhat persistent coal, and it has been designated from the same locality on Brush creek where it and the limestone are seen together. This is the coal which has been erroneously identified with the Elk Lick in this part of Pennsylvania; but since Mr. Platt has determined the true place of the Elk Lick coal bed to be above the Crinoidal Limestone, a local name has been applied to this coal in this report. It occupies, however, the position of the *Gallitzin coal bed* of the Reports on Cambria and Somerset counties (HH, HHH).

At Mr Hain's bank on Brush creek the following section of this bed is seen: (Fig. 5.)

1. Limestone, Brush creek, ...		1
2. Dark shales, ...		10′
3. *Coal*, Brush creek, . .	1. *Coal*, 1′	2′ 5′
	2, Slate, 1″	
	3. *Coal*, 1′ 4″	

The coal is quite good here, except near the top where it is slaty. It is about 75 feet above the Upper Freeport coal at this locality. Near the head of Crow's run, this coal is mined on the land of Mr. Steele, and also Mr. Lovell, where it is three feet thick, and quite good.

On Little Connoquenessing creek a bed of coal four feet thick occurs 50 feet above the Upper Freeport, which I hesitatingly identify with this coal, as the interval is much smaller than usual.

It is mined extensively on a branch of the Little Connoquenessing called Semiconnon, and is there 2 to 5 feet thick. It is a hard, brilliant, richly bituminous coal, and is highly prized as a fuel.

In the western part of Beaver county near the Ohio line, a bed of coal 3 feet thick occurs 50 feet above the Upper Freeport. It is an excellent coal and is very probably the Brush Creek. The same coal is mined one mile south from Enon Valley station by Mr. Pickle and others.

Between the Big Beaver and the Connoquenessing the blossom of this coal is frequently seen 60 to 80 feet above the Upper Freeport. At one point in North Sewickly township, Beaver county, it becomes a bed of *cannel coal*, which is 5 feet thick and tolerably good It is there at Mr. Graham's 75 feet above the Upper Freeport coal. The same coal has also been mined at one or two localities in Allegheny county. In the section at Freeport its blossom occurs 90 feet above the Upper Freeport coal. Where the interval between this coal and the Upper Freeport is small, the Mahoning sandstone below has thinned away to a mere sandy shale in nearly every case, so that this may account for the wide variation.

This is Coal No. VII of Dr. Newberry in the adjoining county of Columbiana, in Ohio

A local limestone, 4 to 6 feet thick, is seen lying immediately under the preceding coal, in the north-western part of Beaver county. It is of a light gray color, and contains much calc spar in cavities It is non-fossiliferous, and comes out of its bed in peculiar slaty-looking, slab-like blocks. It is confined chiefly to Big Beaver township.

A Shale Interval, 20 feet thick, No. 23, occurs in the Section at 530′ to 550′ below the Pittsburg Coal.

The Mahoning (Lower Mahoning) Sandstone, 550′ to 630′ below the Pittsburg Coal, is No 24 of the Section.

We have restricted this name to the massive sandstone which so often immediately overlies the Upper Freeport Coal It is true that both this and the one 90 to 125 feet above that coal, which we have termed the Buffalo sandstone, occur on Mahoning creek, and that both were included by Rogers under the general term of Mahoning Sandstone; but they are such clearly distinct rocks, that, to avoid confusion, each should have a distinguishing title; so that when we speak of either it may be known exactly to which stratum we refer, and not leave the reader to fix it vaguely for himself any where within the limits of a column of rocks 175 feet high.

It may here be stated, that the new names occurring in this report are given merely for convenience and clearness of description of the strata found within this district; since where hitherto unnamed rocks are found persistent over a considerable area it is impossible, without cumbrous repetitions, to write about them unless we give them names.

The Mahoning Sandstone comes up from the bed of the Ohio, at the mouth of Killbuck run, in Allegheny county. Thence rising gradually to the north-west, we find it capping the river bluffs at the mouth of the Big Beaver, 250 feet above the stream, and continuing at nearly the same elevation from this point to the Ohio line.

At some localities we will see it a massive wall of rock 75 feet thick, without a single break, but on following it a short distance it will often change into a mere mass of sandy shales.

The following section, taken near the mouth of Gourdhead run, on Pine creek, in Allegheny county, will show the extreme of variation in the character of this stratum. See Fig. 6, page plate 1:

1. Buffalo S. S , massive, ...	80'	=Upper Mahoning SS.
2. Brush creek limestone, (Philson)	2'	
3. Sandy shales, . . .	7'	
4. *Coal*, Brush creek, (Gallitzen) .	4"	
5. Flaggy sandstone, ...	28'	Lower Mahoning Sandstone.
6 Fire clay and argillaceous shales,	35'	
7 Limestone, ...	5'	
8. Sandstone, shaly, ...	10'	
9. *Upper Freeport coal.*		

The Limestone, No. 7, of this section is quite local, being seen at only this locality in the district.

When the Mahoning sandstone is massive, it is usually a coarse-grained, yellowish-white rock, and frequently contains small pebbles of quartz. It is highly prized as a building stone, and has been largely quarried for that purpose along the Ohio river.

Along Little Buffalo creek this stratum attains an immense development, and is seen resting immediately on the Upper

Freeport Coal, in a vertical conglomerate cliff 80 feet high, while the Buffalo sandstone above it forms an equally massive wall higher up along the hillsides.

Traced west through Butler county the Mahoning Sandstone is seldom massive until we come into Beaver county, where it is quite persistently massive over a wide area.

Opposite Beaver Falls it is seen stretching around the summit of the hill in a bold vertical cliff; and one mile above Smith's ferry it forms a perpendicular wall 75 feet high.

CHAPTER VI.

The Lower Productive Coal Series.

We include under this name all the strata from the base of the Barren Measures down to the Piedmont Sandstone, as Prof. Lesley now terms the upper member of the Pottsville Conglomerate, No. XII.

The productive portion of this series may be said to end with the Ferriferous Limestone; for except over a small area, in the eastern portion of the district, there is no workable coal below that rock within the area which we are considering.

The three sections given on page plate 2; Fig. 7 from Kittanning on the Allegheny river, Fig. 8 from New Brighton on the Big Beaver, and Fig. 9 from Smith's Ferry on the Ohio, near the State line, typify the series, as exposed in this district, in a much more satisfactory manner than any generalized section could do.

The section from Kittanning is introduced only for the purpose of comparing the Allegheny River Series with the same series as displayed further west on the Big Beaver and Ohio rivers.

At Kittanning the Piedmont Sandstone is not seen at the immediate point when the section was made; but a short distance above, it makes its appearance about 40 feet below the Clarion Coal. Summarizing these sections we find the following intervals between important strata at the different points:

From the Upper Freeport Coal—	Kittanning.	New Brighton.	Smith's Ferry.
Distance down to the Kittanning Coal, .	210′	189′	179′
" " Ferriferous Limestone,	261′	263′	242′
" " Piedmont Sandstone, .	350′	340′	283′

It will be seen from this summarization that there is a slight thinning away of the series going westward, which becomes most perceptible after passing the Beaver river.

Section of the Lower Productive Coal Measures exposed on the Allegheny River at Kittanning. (*Fig. 7.*)

1. *Upper Freeport Coal* (E.) not seen.	Freeport Group.	
2 *Upper Freeport Limestone,*		5′
3 Interval concealed, containing the *Lower Freeport Coal* (D) near its base, . .		75′
4. *Freeport Sandstone,*		60′
5 *Darlington* (*Upper Kittanning*) *Coal* (C′), . .	Kittanning Group.	1′ 6″
6 Fire Clay, ...		4′
7 Sandy Shales, ...		6′
8. Fire Clay, ...		3′
9. Flaggy Sandstone, ...		17′
10 Dark Sandy Shales, Nodular Iron Ore, . . .		40′
11 *Kittanning* (*Lower Kittanning*) *Coal* (C), .		3′
12. Fire Clay, ...		5′
13 Sandstone and Sandy Shale, ...		40′
14 Shales containing Iron Ore, ...		5′
15 (*Buhr-stone*) Iron Ore in a plate, ...	Clarion Group.	0′ 6″
16 *Ferriferous Limestone,*		11′ 6″
17 Sandy Shales, ...		15′
18 Very thin Coal bed, ...		0′ 3″
19. Sandy Shale and Sandstone, ...		21′
20. *Clarion Coal,*		1′
21. Fire Clay, . . .		5′
22 Concealed down to Allegheny river bed, ...		55′
Total height of column, ...		373′

Section of the Lower Productive Coal Measures exposed on the Beaver River at New Brighton. (*Fig. 8.*)

1. *Upper Freeport Coal* (E), ...	Freeport Group.	4′
2 Fire Clay, ...		2′ 6″
3 *Upper Freeport Limestone,*.		3′
4 Sandy Shales, ...		35′
5. *Butler* (*Upper Freeport*) *Sandstone,* massive, .		30′
6. *Lower Freeport Coal* (D.), ...		1′ 4″
7 Fire Clay, ...		3′
8 *Butler* (*Lower Freeport*) *Limestone,* .		2′ 6″
9 Sandy Shale and (*Lower*) *Freeport Sandstone,*		75′
10 *Darlington* (*Upper Kittanning*) *Coal* (C′), . .	Kittanning Group.	1′ 6″
11 Dark Shales, with Nodules of Iron Ore, .		35′
12 *Kittanning* (Lower Kittanning) Coal (C.), . .		2′ 6″
13 Fire Clay, ...		10′
14 Sandstone, ...		42′
15. Sandy Shales, ...		30′

16. *Ferriferous Limestone,*		1' to 2'
17. Dark Fossiliferous Shales,		5'
18. Sandstone,		20'
19. *Clarion Coal,*	Clarion Group.	1'
20. Fire Clay,		7'
21. Sandy Shales,		35'
22. *Brookville Coal,*		6" to 3'
23. Fire Clay,		4'
24. Piedmont (?) Sandstone down to river,		30'
Total height of column,		384' 4"

Three Sections of the Lower Productive Coal Measures in Western Pennsylvania.

Fig 7. Kittanning.

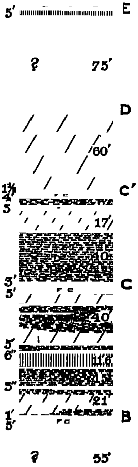


Fig 8 N. Brighton

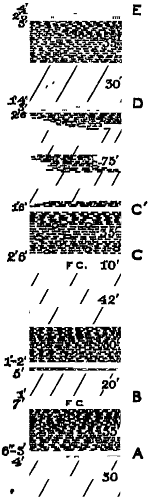


Fig 9 Smith's Ferry.

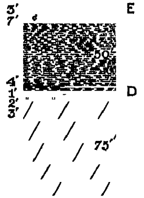
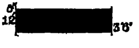


Fig. 17. Darlington.



Section of the Low. C measures exposed on the Ohio River at Smith's Ferry See Fig. 9, on page Plate 2.

1. *Upper Freeport Coal* (E.),		8'
2. Concealed interval,		7'
3. Sandy Shales,		50'
4 Bituminous Shale,	(D.)	4'
5. *Lower Freeport Coal,*		1'
6. Fire Clay,		2'
7. *Butler* (*Lower Freeport*) *Limestone,*		3'
8 (*Lower*) *Freeport Sandstone,*		75'
9 Sandy Shales,		10'
10. *Darlington* (*Upper Kittanning*) *Coal* (C'),		2'
11 Fire Clay,		5'
12. Dark Shales, with Iron Ore,		20'
13. *Kittanning* (*Lower Kittanning*) *Coal* (C),		2' 6''
14. Fire Clay,		10'
15 Sandstone and Sandy Shales,		50'
16. *Ferriferous Limestone,*		1'
17. Sandy Shales,		8'
18 Bituminous Shale,		5'
19 Sandstone,		15'
20 Sandy Shales,		10'
21. Bituminous Shale,		2'
22. *Piedmont?* massive *Sandstone* to river,		+
Total height of column,		285' 6''

These sections can be duplicated in all their main features at many intermediate points between the Allegheny river and the Ohio line; but those given are entirely sufficient to show that all the important strata found on the Allegheny river, are continuous and persistent to the western margin of the State, with only such changes in the character and thickness of the different beds, as we may always expect to find when comparing widely distant sections.

It will also be observed, from an inspection of the sections, that the new name *Darlington Coal bed* has been introduced into the series between the Freeport Sandstone and the Kittanning Coal. In tracing the coal measures from the Big Beaver across to the Allegheny river, I discovered that one of the most persistent and important coals of the series had been omitted from the nomenclature of the First Geological Survey. This serious error was committed, not by overlooking the coal itself, but by wrongly identifying it sometimes with the Lower Freeport Coal Bed above it, and at other times with the Kittanning Coal Bed below it. It happens that when this coal is of workable thickness, the Kittanning below it is often thin and unimportant, and *vice versa;* so that this condition of affairs doubtless led to its confusion with the Kittanning. On the other hand, it was identified with the *Lower Freeport Coal* from the fact that, as in many portions of the district a limestone very similar to the *Freeport Limestone* was found under the Lower Freeport Coal, the Upper F. C. was confounded with the Lower F. C., consequently the Lower Freeport coal was confounded with the coal in question.

I have termed this coal the "Darlington Bed," from its occurrence near the village of that name, in Darlington township, Beaver county, where it is found as a very large bed of cannel coal, yielding what has long been known as the "Darlington Cannel."

[The name "Darlington Coal" may profitably stand in this report, and be used in the district to which it refers; for, at Darlington the bed seems to acquire its maximum size and importance. But there seems to be no sufficient reason for introducing the new name into the list of the coal beds of the Allegheny Valley Series, when, by calling it the "*Upper* Kittanning Coal," we can complete that group and at the same time make it symmetrical with the group of the *Upper* and *Lower* Freeport Coals. Had the classical importance of the worthless little *upper* coal bed at Kittanning been recognized by the geologists of the First Survey they would have given it a name, and that name could hardly have been any other than "Upper Kittanning Coal." We owe to Mr. White's skillful identification of the measures between Freeport and the Ohio State Line our knowledge of the fact; and the result has already been a better adjustment of the names *Upper*, *Middle*, and *Lower Freeport* applied to the beds along the waters of the Redbank and the Mahoning in Jefferson County.—J. P. L.]

The Upper Freeport Coal (E.) *No. VI of the Ohio Survey.*

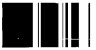
This widely extended bed was found to be much more irregular and erratic in its deposition within the district than had hitherto been suspected. In all of Beaver county east from the Big Beaver there are but two small areas where it is of workable size.

In Butler this coal is of no economical importance over all the western half of the county within the district, as it is rarely more than 1 to 2 feet thick. It thickens up to 4 feet in the neighborhood of Butler, however, and is of workable dimensions over nearly all of the eastern half of the county, where its horizon is above drainage. Very little can be said of its workable extent in Allegheny county, since it is there exposed over only a small area, where brought to the surface by the crest of the Brady's Bend Axis. Where seen it is seldom less than 4 feet thick, and frequently as much as 7′. It is very probable that the western half of Allegheny, like that of Butler, is comparatively destitute of this coal, since on Pine creek it was seen to thin away to almost nothing when followed over the crest of the B.B. Axis to near the southern prolongation of this barren line from Butler county. West from the Big Beaver it thickens up again when traced toward the State line, and becomes a valuable bed of coal, 4′ thick, in the western townships.

It will thus be seen that this coal probably does not extend in a workable bed over more than one half the area of the district. Nevertheless it seldom thins away entirely, as its thin representative is nearly always found ½′ to 1½′ thick when its horizon is exposed.

The structure of this coal, when attaining its normal thickness of 4 feet, is nearly the same in every part of the district. At the top we usually find 6 to 8 inches of impure slaty coal, then comes the main bench, 2½ to 3 feet thick, and always the best coal; below which comes a parting of slate or clay, as is seen in the section, Fig. 10, from Mrs. McCarter's bank, in Chippewa township, Beaver county:

1. Slaty coal,	6″	4′ 3″
2. *Coal*,	2′ 6″	
3 Slate,	1″ to 2″	
4. *Coal*,	8″	
5. Clay,	2″	
6. *Coal*,	4″	

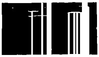


The bottom coal, No. 6, is here quite impure with pyritous slate, as it generally is when showing this structure.

At Lardintown, where the B.B. Axis brings this coal to the surface, near the head of Bull creek, in Clinton township, Butler county, it shows the following structure at Mr. Lardin's bank (Fig. 11):

1. Slaty coal, ... 1'
2. *Coal*, ... 3'
3. Slate, ... ½''
4. *Coal*, ... 6''

} 4' 6''



From Freeport, down the Allegheny river to 1½ miles below Tarentum, this coal has an average thickness of 4 feet; but in the vicinity of Hitestown it suddenly thickens up enormously, and shows as in Fig. 12, at Mr. Hite's drift:

1. Cannel, ... 2'
2. *Coal*, ... 3'
3. Slate and coal, ... 7''
4. *Coal*, ... 3'
5. Slate, ... ¼''
6. *Coal*, ... 4''
7. Slate, ... ¼''
8. *Coal*, ... 1'

} 10'

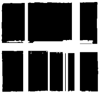
Here the bed is nearly tripple its usual size, which has occurred by the development of a roof coal. The cannel at top is left for the roof, but it is said to burn quite well. The coal is very good, and is extensively mined for the Pittsburg market.

One half mile below Hitestown the coal dips below the Allegheny river.

Where the Fifth Axis* first brings this coal to the surface, at Shawtown, on Pine creek, in Shaler township, Allegheny county, it exhibits again this double bedded structure, as follows, at Mr. Watson's mine (Fig. 13):

1. *Coal*, ... 3'
2. Slate and coal, ... 1'
3. *Coal*, ... 3'
4. Slate, ... ½''
5. *Coal*, ... 6''

} 7' 6''



The coal was once extensively mined at this point, and used in the Ætna rolling-mill, at Sharpsburg. The same structure is also seen in this coal at Mr. Martin's coal-works, on Big Deer creek, and also at Mr Brewer's bank, near the northern margin of the county, on Bull creek.

---

* NOTE.—The Brady's Bend Anticlinal is the same as the Fifth Axis of the First Geological Survey Reports.

From these facts we are led to believe that it will retain its double-bedded character over nearly all of North Allegheny, east from the Fifth Axis; and in that event it may in the remote future become of importance to the manufacturing interests of Pittsburg; for in the city it ought to be reached by a shaft 250 feet deep, while the depth would constantly decrease northward along the Allegheny river, until the coal comes to the surface below Hitestown.

The quality of this coal, however, is quite as variable as its thickness. Where it attains a large size, as at Hitestown and Shawtown, it is tolerably pure, and can be used in the manufacture of iron; but as a general thing it contains too much sulphur for such use. At many localities it is filled with pyritous slate, and its exposed surface is frosted over with copperas. It is rarely used by the smiths; but, for steam and domestic purposes it is a valuable coal to the people of the district. From the western part of Beaver county it has been extensively shipped as a gas coal. This is Coal No. VI of the Ohio reports, in the adjoining county of Columbiana.

Upper Freeport Fire Clay. (No. 2 of Fig. 8.)

Immediately underlying the Upper Freeport Coal, we sometimes find an extensive bed of fire clay. The Summit Cut brick-works, on the Pittsburg, Fort Wayne and Chicago Railroad, gets its clay from this bed. It is there from 8 to 10 feet thick, and makes a fire brick and furnace lining of excellent quality. This is the only locality in the district where the clay has been proved. A specimen analyzed by Prof. Wuth, of Pittsburg, gave:

Water,	12.97
Silica,	57.64
Alumina,	27.86
Lime,	.37
Magnesia,	.12
Alkalies,	.06
Iron,	1.22

The (Upper) Freeport Limestone. (White Limestone of the Ohio Survey) No. 2 of Fig. 7.

This member of the series, unlike its overlying coal, is quite persistent, and retains a somewhat uniform size and similarity of character over the entire district. It thus becomes a very important guide. Most generally it is of a light gray color on fresh fracture, but it nearly always contains enough iron to render it buffish on exposure, and sometimes even enough to constitute it a valuable ore. Occasionally the iron is in the shape of nodules, and these often stand out over its weathered surface, and give it a very rough-looking aspect. It is nearly always more or less *brecciated*, and often looks as though it was composed of the broken and worn debris of some other limestone. It is usually very hard and compact, and is *never fossiliferous*. The most careful search at hundreds of localities having failed to discover anything in the shape of fossils in it, except a minute *univalve* of almost microscopic proportions. The entire absence of organic remains from this limestone is a very singular feature when taken in connection with the fact that other limestones of the coal measures, both above and below it, are crowded with them, and it may well point to a marked difference in the condition of their deposition.

This limestone may be of fresh water origin, having accumulated as a calcareous mud at the bottom of some inland lake. It contains so much earthy matter and other impurities, that it is often very difficult to get it to slack, and hence it has rarely been burned. Its average thickness is about three feet, though in a few localities, as at the top of the Summit Cut, on the Pittsburg, Fort Wayne and Chicago Railroad, we find it in several layers, distributed through 8 or 10 feet of shales. It is the "White Limestone" of Dr. Newberry, in Columbiana county, Ohio.

The Butler Sandstone—Upper Freeport Sandstone.

The interval between the Freeport Limestone and the Lower Freeport Coal, is usually occupied by sandy shales and thin layers of flaggy micaceous sandstone; but occasionally, as in the valleys around the town of Butler, these strata thicken up into a very massive rock.

At the town of Butler it comes in a few feet below the Upper Freeport Coal, and extends down almost to the Lower Freeport, being about 50 feet thick. It has been extensively quarried near the cemetery there, and is a coarse, reddish-white, and very massive sandstone. Although not persistent enough as a massive Sandstone to be marked as such in a general section of the rocks of this district, whenever it is encountered in this report it will be called the Butler Sandstone.

On the Allegheny river, below Tarentum, it is seen cutting out everything up to the immediate floor of the Upper Freeport Coal.

Opposite New Brighton and Beaver Falls at this horizon we get a very massive sandstone capping the bluffs and it was here mistaken for the *Mahoning* Sandstone by the First Survey and also by myself in a paper read before the Lyceum of Natural History in New York in 1873, as I simply accepted, without question, its identification by other geologists.

*The Lower Freeport Coal.** (D.) (*Ohio, No. V.*)

This member of the series was found to be of almost no economic importance; for in the district it attains workable dimensions at only a few localities; although exposed over a wide area in both Beaver and Butler counties. It is singularly persistent, however, either as a small coal bed, or a richly bituminous shale. It is frequently represented by a few inches of coal at the bottom of a deposit of bituminous shale from 3′ to 10′ thick, which has often been explored for cannel coal.

In the vicinity of Baden, in Beaver county, this coal attains a thickness of 2½ feet, over a small area, and has there been mined for a number of years. It is a rather poor coal, however, being slaty and impure.

At the mouth of Breakneck creek, on the Connoquenessing, it becomes a workable bed, and is known as the "Schantz Coal." It is there 2½ to 3 feet thick, and a very pure and excellent coal

---

*The *Middle Freeport Coal* of reports H, HH, HHH.—The restoration of the old name of *Lower Freeport* coal is explained in the preface to HHH.

On Trough run, opposite Beaver Falls, this coal is seen at one point 4 feet thick, in a bed of impure cannel.

In the western part of Beaver county it has been mined in a few instances, but the openings are now all abandoned, and very little could be learned of its thickness or quality

It is No. 5, of Dr. Newberry, along the Ohio river.

*The Butler Limestone—Lower Freeport Limestone.**

Coming 3 to 5 feet below the Lower Freeport Coal, we often find a limestone very similar in character and size to that which underlies the Upper Freeport Coal.

The existence of a limestone at this horizon never having been recognized by the geologists of the First Survey, they were in consequence frequently misled, mistaking it for the *Upper* Freeport limestone, and mistaking consequently the coal above it for the Upper Freeport Coal; and this in its turn led to other mistakes in the column below, such as we have already indicated in connection with the Darlington coal or Upper Kittanning Coal bed.

This limestone does not occur at Freeport, and it is by no means persistent, but it would probably be found in about one section out of four taken at random over the district. Though very much resembling the (Upper) Freeport limestone, it is readily distinguishable from it by any one who becomes thoroughly familiar with both. It is always more ferruginous, and earthy, and less compact than the higher stratum. It almost invariably contains small nodules of concretionary iron ore, and at times these are seen protruding from its surface in countless numbers.

Iron Ore.—In the eastern part of Butler county a valuable bed of carbonate of iron ore rests immediately upon this stratum, and the old Winfield Furnace on Rough run obtained its ore principally from this horizon.

This limestone is seen at Butler in a cutting near the railroad depot, and has been named from that locality. In the Summit Cut of the Pittsburg, Fort Wayne and Chicago Railroad it is seen near the level of the track at its highest point, and in Columbiana county, Ohio, it is seen near Palestine, along the road which passes down Leslie's run. It is always non-fossiliferous, and was doubtless accumulated in a manner similar to the (Upper) Freeport limestone. It varies in thickness from 2 to 5 feet.

---

*This is the Middle Freeport Limestone of the Cambria and Somerset Reports HH, HHH: Explained page 819, HHH.

The Freeport Sandstone. (Lower Freeport Sandstone.)

This member of the series, when massive, is usually a moderately coarse, hard, micaceous, ashen-white rock, and often exhibits much false bedding, while many of the layers appear to have a twisted and gnarly structure

Along the Ohio river, in Beaver county, this stratum attains an immense development, being seen near Industry in a bold massive cliff, 120 feet high, without a single break. It is also quite a massive rock along the Little Beaver, and some reaches of the Connoquenessing Along the Big Beaver, however, it becomes shaly, and opposite Beaver Falls *a local bed of cannel coal* 5 feet thick is seen in the center of the mass for a few rods, and the same thing occurs at one point on Brady's run.

Owing to its hardness this rock is seldom used for building purposes. It rarely contains any quartz pebbles, and in this respect is readily distinguished from the Mahoning Sandstone at the base of the Barren Measures above. It varies in thickness from 70 to 120 feet.

*A Local Coal (Brady's Bend Coal?).**

Where there is a shale interval of 20 to 30 feet between the Freeport Sandstone and the Darlington Coal, we sometimes see a small impure coal from a half to one foot thick immediately under the sandstone. It is seen at Smith's ferry, New Brighton, and two or three other localities, but never attains any importance, as it is always slaty and worthless.

---

* Inserted with a question into J. P. Lesley's section at Brady's Bend; see p. 319, Report of Progress HHH.

The Darlington (Upper Kittanning) Coal (C'.) = *Ohio Strip Vein and No. IV (Lower Freeport of IIHH.)*

This is the bed to which we have previously referred as having been so confounded with the Lower Freeport coal above it, and with the Kittanning coal below it, that the corps of the First Survey failed to recognize it as a distinct and separate bed. Its usual horizon is 5 to 20 feet below the Freeport Sandstone, but we frequently find that massive rock resting upon it Although often quite thin, it appears to be almost universally persistent throughout the district, and is a very important bed.

On the Connoquenessing it rises out of the bed of the stream about seven miles above Harmony, and is constantly accessible and of workable thickness from that point down to the mouth of Slippery Rock. It is known as the "*Creek vein*" in the vicinity of Harmony, since it is found at only a few feet above the level of the stream for several miles. At Harmony it shows the following structure which typifies it all along the Connoquenessing, Fig. 14:

1. *Coal,*	1' 10''	2' 5''
2 Slate, ...	1''	
3. *Coal,*	6''	

The parting of slate is sometimes near the middle of the coal, and is nearly always present. Along the Connoquenessing it contains considerable sulphur at some localities, but seldom enough to unfit it for smithing purposes, and it is generally a brilliant, rich, and oily coal.

On Yellow creek, a tributary of the Little Connoquenessing, this coal is mined to a considerable extent, and is there about three feet thick. It is the chief source of supply for all of the West of Butler within the district.

On the Big Beaver it has been extensively mined between Clinton and Homewood, and shipped as a gas coal. Along this line it shows the following structure, Fig. 15:

1. *Coal,*	2' 5''	2' 10'
2. Slate, ...	1''—1½''	
3. *Coal,*	4''	

It is here a splendid coal and very rich in volatile combustible matter.

Followed down the Big Beaver from Clinton it thins away to only 18 inches before reaching Homewood, and continues thin until we come to Bennett's run, 3½ miles above New Brighton, when it again thickens up to 3 feet, and is mined on that stream by Mr Dougherty and others, where it is a most excellent coal, and so much superior to the Kittanning that many families in New Brighton and Beaver Falls get their fuel from it in preference to using the Kittanning bed coal at a much less cost per bushel

Passing down the Beaver from this point, it soon thins away, and although remarkably pure, it is no longer of workable thickness along that stream, and it is seldom more than 18 inches thick and frequently less. In the vicinity of New Brighton it is called the "*Eighteen inch*" or "*Blacksmith vein*," since it is preferred by the smiths to any other coal which they have ever used, not excepting the Pittsburg.

Along the Ohio it is constantly present, but never workable until we come to the neighborhood of Smith's Ferry, when it again thickens up and is mined in that vicinity, where it shows the following at Mr. Udick's bank, Fig. 16;

1. *Coal*, ...	1' 7''	2'
2. Slate, ...	1''—2''	
3 *Coal*, ...	8''	

Here the bottom, No. 3, is sulphurous and worthless but the top bench is almost unexcelled for purity and richness.

From this point it is easily traced up the Little Beaver, until it culminates in the great bed of cannel coal 3 miles below Darlington, on the property now owned by Mr. Mansfield, where it shows the following structure and variations, Fig. 17, given on page Q. 41:

1. Cannel slate, ...		0' to 6'
2. Cannel coal, ...	Max. 15'	0' to 12'
3 Bituminous coal, . . .		0 to 3½'

These measurements should be understood as showing the variation at different points, for the whole bed never shows a thickness of more than 15 feet at any single point, and never more than 12 feet of workable coal.

This is a mere local deposit, as it has never been found on any of the adjoining farms, or any where else in the county. The whole bed is subject to frequent and rapid variations when followed in certain directions. The coal may be 10 feet thick, when the massive Freeport Sandstone which forms its roof will begin to come down, and at the same time the floor of the coal will begin to rise until the two meet, and the coal is quite cut out in a very short distance.

The cannel has an average thickness of 7 feet, and passes gradually into the cannel shale above It nearly always rests upon ½ to 1 foot of bituminous coal, which also contains streaks of cannel.

On one side of the farm where the *cannel* was thinned away, the bituminous part becomes 2 to 3½ feet thick. Both are extensively mined and shipped to Cleveland by Mr. Mansfield The *cannel* contains a large per cent. of ash.

Origin of Cannel —It is worthy of note as bearing on the origin of cannel, that here there is no fire clay under it whatever, but it rests immediately upon a dark sandy shale which is crowded with finely preserved plants. This certainly shows that in the case of this coal at least, it could not have accumulated from vegetation grown *in situ*, but as Dr. Newberry has already suggested with regard to the origin of cannels, was probably drifted as a carbonaceous mud into the waters of some quiet lagoon The very irregular and local nature of the deposit confirms this.

In the eastern portion of the district this coal is above drainage over a very small area only.

On Big Buffalo creek 2½ miles above Freeport it is brought to the surface for a short distance, where it is seen to be 2½ feet thick, with the massive Freeport sandstone resting immediately upon it.

It is probably this coal which is mined by Mr. Kearns 2 miles above Butler, where it is 2′ 10″ thick and a very fair coal This is coal No. IV of Dr Newberry along the Ohio river, and the "Strip Vein" of Yellow creek.

Darlington Plant-Bearing Shale.

Forming the immediate floor of the great bed of cannel coal, three miles below Darlington, which has just been described, we find a dark sandy shale, which is perfectly filled with plant remains

To the intelligent and enthusiastic proprietor of the cannel coal mines, Mr. I. F. Mansfield, the Survey is indebted for one of the finest collections of fossil plants that has ever been made at any single locality in the country.

From this shale, which is only 2 to 3 feet thick, Mr. Mansfield has generously collected at his own expense, and forwarded to Prof. Lesquereux, the Fossil Botanist of the Survey, the following list of plants, which have been identified are kindly furnished me by that eminent Palaeobotanist:

- CALAMARIA.
  - Asterophyllites.
    - *equisetiformis;*
    - *foliosus,*
    - *sublævis.*
  - Calamites.
    - *approximatus;*
    - *Suckowii;*
    - *ramosus;*
    - *nodosus.*
  - Sphenophyllum.
    - *Schlotheimii,*
    - *longifolium:*
    - *emarginatum.*
  - Annularia.
    - *sphenophylloides;*
    - *longifolia.*
  - Equisitites.
    - *infundibuliformis.*
  - Calamostachys.
    - *tuberculata.*
- FILICES.
  - Cyclopteris.
    - *trichomanoides;*
    - *obliqua,*
    - *elegans,*
    - *undans;*
    - *fimbriata.*
  - Neuropteris.
    - *angustifolia;*
    - *cordifolia,*
    - *hirsuta,*
    - *Clarksoni,*
    - *flexuosa,*
    - *tenuifolia,*
    - *vermicularis;*
    - *plicata,*
    - *Loschii;*
    - *crenulata,*
  - Odontopteris.
    - *Schlotheimii;*
    - *Brardii?*
    - *Reichiana?*
  - Dictyopteris.
    - *obliqua.*
  - Callipteridium.
    - *Mansfieldi.*
  - Alethopteris.
    - *ambigua,*
    - *lonchitica,*
    - *Serlii;*
    - *Sullivantii;*
    - *nervosa;*
    - *Pluckeneti.*
  - Pecopteris.
    - *hemiteloides;*

microphylla;
truncata;
Sillimani;
squamosa;
plumosa,
polymorpha,
chærophylloides.

SPHENOPTERIS.
Newberryi,
mixta,
artemisiæfolia,

HYMENOPHYLLITES.
lactuca,
laceratus;
Gutbierianus;
expansus.

SPIROPTERIS.
villosa.

STEMMATOPTERIS.
Mansfieldi.

CAULOPTERIS.
obtecta.

LYCOPODIACEÆ.

LEPIDODENDRON.
obovatum;
Sternbergii;
quadratum;
modulatum.

LEPIDOPHYLLUM.
undulatum;
Mansfieldi,
auriculatum;
foliaceum.

LEPIDOSTROBUS.
ornatus;
variabilis.

LEPIDOPHLOIOS.
laricinus.

SIGILLARIÆ.

SIGILLARIA.
monostigma;
alternans;
reniformis;
mamillaris;
sculpta,
elliptica,
tessellata.

SYRINGODENDRON.
pes-caprioli,
cyclostigma.

STIGMARIA.
ficoides.

CORDAITES.
borassifolia;
principalis,
Mansfieldi,
reflexa.

DICRANOPHYLLUM.
species.

CORDIANTHUS.
fl. masculina (1 species).
fl femina. *Antholithes* (2 species).

ARTISIA.
transversa.

FRUCTUS.

CARPOLITHES.
vesicularis;
multistriatus;
platimarginatus;
clypeiformis;
fraxiniformis;
Canneltoni,

RHABDOCARPUS.
Bochsianus,
clavatus,
amygdalæformis.

TRIGONOCARPUS.
Daviesii.

CARDIOCARPUS.
mamillatus.

RADICES.

PINNULARIA.
capillacea.

FUNGI.

RHIZOMORPHA.
sigillariæ.

Besides this list there are many more species which have not yet been determined. Several are new to science, and the number of species already found is more than one hundred.

All these plants were obtained within an area of a few square yards. Too much praise cannot be bestowed upon Mr. Mansfield for his generous and enthusiastic work freely given to advance the interests of the Survey in this department of science. Besides the plants, Mr. Mansfield has also found a very fine new species of crustacean in this shale, which has been named in his honor by Mr. Charles E. Hall, the palæontologist of the Survey, *Eurypterus Mansfieldi* (subgenus *Dolichopterus*.)

Under this same coal, at a locality on Brush creek, in Marion township, Beaver county, where the coal shows great irregularities, we find a shale which is apparently equally rich in plants with the locality at Mr Mansfield's. This is at Mr. Newton's bank, near Mechanicsville.

(*Kittanning Ferriferous Shale and Ore* [*])

The interval which separates the Darlington and Kittanning coals is occupied by a shale which nearly always exhibits a constant character. When thickest, as at Kittaning, it consists of a flaggy sandstone at top, which soon passes down into a dark sandy and argillaceous shale that invariably contains iron ore, in balls and kidney-shaped nodules, and occasionally in regular layers. Sometimes it occurs in great quantities, and some of the nuggets are a foot in diameter.

Opposite Zelienople, along the banks of the Connoquenessing, below the mill, this ore is seen in great abundance.

The old Charcoal Furnace on the Connoquenessing below Zelienople obtained its ore from this horizon. The ore may average from 30 to 35 per cent, of metallic iron.

---

[*] This may very well be the representative of the *Johnstown Cement Bed* of W. Platt's Somerset County Report of Progress HHH. The reader will therein find an account of the error committed by the Geologists of the First Survey, in their early study of Western Pennsylvania, in confounding *this ore bearing* calcareous stratum with the *much lower* "Ferriferous Limestone" carrying the *ores* of Clarion, Armstrong, and other counties in the Allegheny River Valley country.—*J. P. L.*

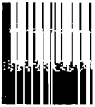
This Kittanning Shale shows a marked decrease in thickness when followed from the Allegheny river west to the Ohio line At Kittanning, the interval is 70 feet; at Harmony, on the Connoquenessing, it is 50; on the Big Beaver, it is 35, while on the Ohio, at the State line, it is only 20′.

The Kittanning Coal, or Lower Kittanning Coal. (C.) = *Ohio No. III.*

This coal is entirely persistent, though in a few instances it becomes too thin, or too impure to work.

In the eastern part of Butler county it is brought to the surface over a small area by the Fifth Axis. There it is generally about three feet thick, but on the west branch of Big Buffalo creek, in Clearfield township, it shows some singular vagaries, and exhibits the following section at Mr. Deener's bank, Fig. 18.

1. *Coal,*	2′	8′
2. Shale,	6″	
3 *Coal,*	2′	
4. Shale,	1′	
5. Coal,	2′ 6″	



Here we get a mass of shale and coal 8 feet thick. The coal is mined by stripping, and is quite good, though the bottom part is best. It shows pretty much the same structure for two miles along Buffalo creek, but just as that stream passes out of Clearfield township, into Armstrong county, it regains its single-bedded structure and normal size of 3 to 3½ feet in thickness.

The Fifth or Brady's Bend Anticlinal Axis also brings up this coal on Rough run, in Winfield township, and it was once extensively mined there and used at the Winfield Furnace, but no mines in operation on it now.

Plunging under the high lands of central Butler over the arch of the Fifth Axis, the coal does not again come to the surface to the west until we come to the mouth of Camp run, on the Connoquenessing, in Beaver county, where it reappears 2 feet thick, with *an immense bed of fire clay* beneath it.

At no point on the Connoquenessing between Butler and this point is it more than 120 feet below the surface, and for the greater portion of the distance not more than 50, and as numerous borings indicate a considerable thickness for it, the time may come when it would pay to shaft it, should the projected railroad from Butler down the Connoquenessing ever be built.

At Harmony it is only 40 feet below the creek, and a boring indicates a thickness of 6 feet. Followed down the Connoquenessing from where it makes its appearance at the mouth of Camp run, we find it worked occasionally, but it is seldom more than 20 inches thick, and is overshadowed by the Darlington above it. It continues thin and unimportant down around the Big Beaver, until we pass below Homewood, when it again thickens up and becomes a valuable coal in the vicinity of New Brighton and Beaver Falls, where it shows the following structure at most of the banks: See fig. 19.

1. *Coal*,	6″	2′ 2″
2. Slate,	1″	
3. *Coal*,	1′ 7″	

The lower bench is generally the purest. This part of the coal is coked above Beaver Falls by Mr. Davis, and Mr. Holmes. It makes a beautiful compact and silvery coke, and is used to a considerable extent in the manufactories of Beaver Falls.

The upper bench is hard, dull, and contains considerable pyrites

Along the Ohio river this coal becomes filled with pyritous slate, and is in many places utterly worthless, though it retains a thickness of 2½ to 3 feet. At Industry it is locally a very fair coal; but passing below that it again becomes bad and is known as the "Sulphur vein"

On the Little Beaver this coal is extensively mined for domestic consumption in the vicinity of Darlington, where it is 28 inches thick and an excellent coal.

This is coal No. 3 of Dr Newberry, along the Ohio river.

The Kittanning (New Brighton) Fire Clay.

Immediately underlying the Kittanning coal in every portion of Beaver county, we find an immense bed of fire clay. It gives rise to an important industry in the making of fire-brick, furnace linings, &c

At new Brighton Messrs. Elverson & Sherwood have a large Terra-cotta establishment, where flower pots, statuary, chimney tops, and all kinds of ornamental and rustic work are manufactured from this clay Their wares took the first premium at the Pittsburg Exposition in 1875.

The largest fire-brick establishment is that of Barnes & Co, in Bridgewater This company have furnished fire-brick to nearly all the furnaces in the Mahoning and Shenango valleys.

The bricks do not withstand the highest degree of heat, but they are especially desired for those portions of the stack where there is considerable friction, as they withstand this better than almost any other obtainable brick.

This bed of clay is seldom less than 10 feet thick, and in some cases as much as 15. Usually not more than 6 or 7 feet of it is used, as the bottom becomes too silicious. This is the same bed of clay which is so extensively worked along the Ohio river, in Columbiana county, Ohio.

The Kittanning (Industry) Sandstone and Shale.

Immediately below the fire clay there generally occurs a sandstone, which is often quite massive.

At Industry, on the Ohio, it is 50 feet thick, and rests, as a massive vertical cliff, immediately upon the Ferriferous Limestone.

Above the old Winfield Furnace, on Rough run, in Butler county, it attains an immense development, and at one point *it cuts the underlying limestone abruptly away where it had a thickness of 18 feet.*

The lower part of this interval down to the Ferriferous Limestone is, however, more generally of a shaly nature, and often contains considerable iron in scattered nodules. While the interval between the Kittanning and Darlington Coals, shows a marked thinning away when followed to the west from the Allegheny river, this interval between the Kittanning Coal and the Ferriferous Limestone shows quite the reverse; for at Kittanning the interval is 50 feet, while at New Brighton, on the Beaver, it is 82, thus almost exactly *counterbalancing* the thinning away of the former; for the Darlington Coal is 123 feet above the Ferriferous Limestone at Kittanning, and 120 at New Brighton.

The Buhrstone iron ore which often rests immediately on the limestone next to be described in many parts of Pennsylvania, does not attain much importance at any point within the district, as it is usually too thin to warrant mining.

The Ferriferous (Vanport) Limestone.

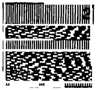
This is the most characteristic stratum in the series. It is the largest, purest, and most massive limestone, and always possesses a peculiarity of composition and organic remains, by which one thoroughly familiar with it can unerringly distinguish it at a single glance from any other limestone in the group. On the Allegheny river, at Kittanning, this limestone is 12 feet thick; at the eastern edge of Clearfield township, Butler county, where it passes under Buffalo creek over the arch of the Fifth Axis it is 15′; on Rough run, in Winfield township, where it is brought to the surface by the same axis, and extends around the hill in a massive cliff, like a sandstone bluff, we find it 18 feet thick.

West from these localities, it passes under the highlands of Butler county, and although frequently reported in borings, is seen no more until we come into Beaver county, near the mouth of Brush creek, where it rises from the bed of the Connoquenessing, but greatly reduced in thickness, being only 1 to 2 feet thick, and sometimes disappearing entirely. But it soon begins to thicken, and three miles below the point of its first appearance we see it 20 to 25 feet thick making huge cliffs along the stream.

It maintains this unusual development down the Connoquenessing to its mouth, and thence down the Big Beaver to the old Homewood furnace, where it has a thickness of 15 feet. Below this it rapidly thins away to a feather edge on top of the great Piedmont Sandstone, which here begins to thicken up preparatory to its maximum exhibition at Homewood station, three miles below.

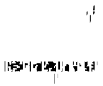
South of Homewood the Ferriferous Limestone comes in again as the Piedmont Sandstone begins to thin away at top, but it is now only 1 to 2 feet thick. It is, however, perfectly persistent, and at the lower extremity of New Brighton begins again to thicken up and exhibits the following structure near the mouth of Paved run, Fig. 20:

1 Gray compact limestone,	2'	8'
2. Shale,	1½'	
3. Bluish gray limestone,	1'	
4. Shales,	3'	
5. Bluish impure limestone,	½'	



This is about three miles above the mouth of the Big Beaver, and going south to the Ohio it is seen to be getting thicker and more massive, and near Vanporte on the Ohio, 3 miles below the mouth of the Big Beaver, it is extensively quarried and shows the following section at Mr. Tygart's quarry, Fig. 21:

1. Gray limestone,	7'	18'
2. Shale,	1'	
3. Gray limestone,	5'	
4. Blue limestone,	5'	



Here it is 35 feet above the Ohio, but below this the river flows more to the south, and it dips down near its level and is constantly concealed by the terrace deposits until we come to Industry, 4½ miles from the Ohio line.

Here opposite the mouth of Six Mile run the Ohio has eroded the terraces from its southern shore, and the limestone is seen 15 feet thick on the land of Mr. Allen, where it has also been quarried.

At this locality a fine illustration of its *sudden variations* in thickness is seen. At the quarry it is fifteen feet thick;

but as we pass down the river it is seen to become gradually sandy and earthy, until, only ¼ of a mile below, the whole stratum, except a small impure layer 6 inches thick at the top is replaced by sandy shale. This change is seen actually taking place, as the entire section is perfectly exposed between the two points.

Below Industry this stratum is again covered up by the terraces, and is seen no more until we come to the mouth of the Little Beaver, near the Ohio line, where it appears near the level of the railroad track 1 foot thick, 60 feet below the Kittanning coal.

This limestone when of its normal thickness (12 to 15 feet) is generally of an ashen-gray color to near its base, when it changes to a light blue Along the face of the rock it weathers in a peculiar manner, being traversed by horizontal furrows ¼ to ½ inch deep and ½ to 1 inch apart. These furrows have a wavy margin and thus give to the stone a shrunken, or shriveled appearance.

When this stratum becomes thin it invariably exhibits the "*cone-in-cone*" structure, and then looks as though it had segregated from the calcareous mud above and below it.

The limestone itself when it is thick, and the shales immediately below it when it is thin, are always richly fossiliferous.

In it I have seen the following fossils within the district: *Spirifer cameratus*, *S. lineatus*, *S. opimus*, *Productus Nebrascensis*, *P. longi-spinus*, *P. Prattenanus*, *P. semi-reticulatus*, *Hemipronites crassus*, *Chonetes mesoloba*, *Euomphalus rugosus*, *Pleurotomaria Grayvilliensis*, *P. carbonaria*, *P. turbinella*, *Bellerophon carbonarius*, *B. Montfortianus*, *B. percarinatus*, *B. Stevensanus*, *Nucula ventricosa*, *Nuculana bellistriata*, *Macrocheilus primigenius*, *M. ventricosus*, *Astartella concentrica*, *Polyphemopsis peracuta*, *Aviculo-pecten carbonarius*, *A. Whiteii*, *Athyris subtilita*, *Solenomya radiata*, *Macrodon obsoletus*, *Aviculopinna Americana*, *Nautilus occidentalis*, *Platyceras tortum*, *Synocladia biserialis*, *Lophophyllum proliferum*, *Orthoceras cribrosum*, *Zeacrinus mucrospinus*, and numerous fragments of crinoids, the long stems of which are often seen stretching across the stone in every direction

This stratum is extensively quarried at Vanport, on the Ohio. It burns into an excellent white lime, and is also highly valued as a flux for iron. It is the only limestone in the series which can be used for that purpose.

The Clarion Coal. (*B.*)

This coal is found of workable dimensions in the eastern portion of the district only. Where brought above drainage, on Rough run by the Fifth Axis, it is from 3 to 4 feet thick, and a tolerably fair coal. It is accessible, however, for only one mile along this stream, and is seen no more within the district until we come west into Beaver county, at the mouth of Brush creek, where it rises from the bed of the Connoquenessing, and is 1½ feet thick. Along the Big Beaver it is nearly always found at 20 to 30 feet below the Ferriferous Limestone, but is seldom more than 1 foot thick.

A large Bed of Fire-clay, 7 to 10 feet thick, the lower part of which is non-plastic, underlies the Clarion Coal along the Big Beaver.

The Brookville Coal. (*A.*)

The horizon of this coal is above drainage for only a few rods in the eastern portion of the district, on Rough run, where the Fifth Axis crosses that stream, and, as the interval where it should come is there concealed, it was not seen.

Along the Big Beaver, however, we frequently see a coal which corresponds to this one, resting with its underlying fire-clay immediately upon the Piedmont Sandstone. It is separated from the Clarion coal by an interval of 30 to 50 feet, which is occupied by shales and flaggy sandstone.

At an old drift, 2½ miles above Beaver Falls, it shows the following, Fig. 22:

1. *Coal*, ... 1′ 2″ }
3. Shale, ... 3′ } 4′ 9″
4. Coal, ... 7″ }

The coal is slaty and worthless. It attains workable dimensions at the mouth of Brady's run, below New Brighton.

It is there 3 feet thick, and was once mined and used at the old salt-works. It is reported to be quite slaty, however, and has long been abandoned.

In the section at Smith's Ferry, both this and the Clarion coals have thinned away, and are represented by bituminous shales.

CHAPTER VII.

The Beaver River Group.

The Piedmont, or Upper Homewood Sandstone; Inter-Conglomerate Beds; Connoquenessing, or Lower Homewood Sandstone; and Sharon, or Sub-Conglomerate Beds.

[In his MSS. of this Report, Professor White has accepted for this group of rocks the name "*Conglomerate Series*," given to it in West Virginia by Prof William M. Fontaine, in articles written for the American Journal of Science and Arts, Vol. XI, and published in April and May, 1876

As our survey of the Bituminous Coal Fields of Pennsylvania is not yet by any means completed,—as the actual number and co-ordination of beds of this group along the extension of its northern out-crop eastward into the Upper Allegheny River and Genesee River Country is still a subject of painful investigation,—as a satisfactory harmony between the *Pottsville Conglomerate* and its coal beds in Lyken's Valley and at Shamokin with the lowest coal beds, sandstones and conglomerates of Lycoming, Potter, Cameron, McKean, Warren and Venango counties is yet to be obtained,—as I foresee the probability that the whole group of Pottsville (*Seral*) Conglomerate rocks, containing as it does large and valuable beds of coal. will some day be considered as included in the series of the *Lower Productive Coal Measures*, as it certainly is in the *Allegheny River Coal Series*,—and, finally, as the Conglomerate, No XII, (whether called Seral Conglomerate, Pottsville Conglomerate, Piedmont Sandstone and Pottsville Conglomerate, Upper and Lower Homewood Sandstone, Homewood Sandstone and Connoquenessing Sandstone, Massillon Sandstone, for by all these names has one or both of its principal members been designated,) may be considered the base or bottom member of the *Lower Productive Coal Series*, as justly as the Mahoning Sandstone is considered the bottom member of the *Lower Barren Measures*, the Connellsville Sandstone the bottom member of the *Upper Productive Coal Series*, and the Waynesburg Sandstone the bottom member of the *Upper Barren Measures*,—for all these reasons I am unwilling to fix the name "Conglomerate Series" in the permanent literature of the Survey, by use in this volume.

For local use however in Western Pennsylvania there is no objection to the term *Beaver River Group*, provided it be clearly understood that the term has the same systematic value as those of the *Freeport*, *Kittanning* and *Clarion Groups:* and that the group is the *lowest part* of the well established *Allegheny River Series*, being synonomous with the so-called *Sharon Coal Series*, a name adopted by Mr. J. T Hodge in the first geological survey of the Beaver River waters, forty years ago, and retained by Prof. H. D Rogers in his Final Report of 1858.—J. P. L]

This group of rocks is exposed in Beaver county only along the Big Beaver and Connoquenessing Creek, where it exhibits the following typical section, Fig. 23 :

Typical Section of the Beaver River Series, as exposed along the Beaver River and the Connoquenessing Creek :

1. *Piedmont* [?] *Upper Homewood Sandstone*, massive, conglomeratic, ...	75' to 155'
2. Shales, sometimes enclosing a *coal bed* (1' to 2' 6'' thick) at the top; below which comes in a horizon of *iron ore*, and the *Mercer Limestone*, with sometimes a thin *coal bed* below that again, ...	20' to 80'
3. [*Pottsville Conglomerate*] *Connoquenessing Sandstone*, *Massillon Sandstone* of Ohio.	
(a.) Upper member, a very massive, hard, white sandstone, ...	40' to 50'
(b.) Middle member, darkish, sandy shales, generally containing *iron ore* at the top, and sometimes a thin *coal* below, . . .	35' to 40'
(c.) Lower member, a hard, massive, greyish-brown sandstone, .	20' to 25'
4. *Sharon Shales.* Dark shales containing a stratum of *iron ore* at the top (1' thick), and filled, below, with *fossil plants* characteristic of the *Sharon Coal*, and containing thin layers of *coal* in the lowest exposed part. Thickness seen exposed above the bed of the Connoquenessing Creek, . . .	7'
Total height of column 225', mean of	197' & 257'

The Upper Homewood Sandstone, No. 1, of the above section, is supposed to be the representative in this district not only of the *Piedmont Sandstone*, in the Cumberland Coal Basin in Maryland, along the Allegheny Mountain in Centre, Blair, Cambria and Somerset counties (see Reports H, HH, and HHH,) and on Laurel Hill and Chestnut Ridge in Fayette and Westmoreland counties, Pennsylvania (see Reports KK and HHHH,)—but also of the great sand-rock which extends in an unbroken sheet through McKean and Forest counties, in the north, to which was given, forty years ago, the name of *Tionesta Sandstone* which in that country it still retains.

It reaches its maximum development in this district at Homewood station, where it appears in one solid unbroken ledge 155 feet thick. This size is attained by the top of the rock extending far up above its usual horizon, and cutting out the members of the Clarion Coal Group to above the Ferriferous Limestone, thus forming a striking exception to the generalization made by Mr. Wrigley in his Special Report on Petroleum (J), that the variation in thickness of all the sandstones is from the base.

This rock at Homewood is a very massive yellowish white sandstone. It is tolerably coarse grained, and many of its layers are filled with quartz pebbles varying in size from a pea to a hazle nut. It is an excellent building stone and is quarried largely for that purpose.

At Homewood its base is 100 feet above the Big Beaver river. Passing down the stream it dips very rapidly to the south, until, at 3½ miles below, its bottom comes to water level, and about 4 miles further down, near the mouth of Brady's run, its top also disappears beneath the level of the Big Beaver river

The borings at Beaver Falls and New Brighton commence immediately on the top of this stratum, and show that it is there 60 to 75 feet thick.

Its top reappears on the Ohio river above Smith's Ferry, and is seen at low-water mark. At that locality it is the rock on which the rude carvings of men and other objects made by the aborigines are to be seen.

On Little Beaver its top may be noticed rising above the water a short distance above the railroad bridge.

Traced north and north-east from Homewood, it rapidly thins away, and all the upper portion becomes shaly, so that we sometimes find two or three small coals in this portion of it along the Connoquenessing creek.

The Mt. Savage (?) Coal Bed.

Immediately below the Piedmont Sandstone, we find a small coal at several localities along the Big Beaver. One and a half miles above Homewood, it becomes workable, and has been mined by Mr. Beatty, where it sometimes attains a thickness of 2½ feet It is very irregular, however, as the sandstone above often comes down and cuts it almost entirely away. It is a tolerably fair coal and appears to contain very little pyrites

In its roof shales at this locality are seen immense numbers of *Cardiocarpa* and *Cordaites*, associated with a fern which I was unable to distinguish from *Odontopteris neuropteroides*, Newb'y At Homewood, the coal is seen as a mere streak at the base of the sandstone; and in the borings at Beaver Falls and New Brighton it is reported as 8″ to 12″ thick

The Mercer (Lower Wurtemburg) Limestone.

A few feet below the coal, just described, there comes into the section, in the vicinity of the Old Homewood furnace, a very characteristic little limestone, which I have identified with the Mercer Limestone of the First Survey.

At the Old Furnace it is separated from the Ferriferous Limestone above by an interval of 135 feet. It is tolerably compact, has a dark bluish color, and is filled with fossils. It varies from 8 to 12 inches in thickness, and is quite persistent from this point up the Beaver and Connoquenessing to Wurtemburg, where it is the Lower Wurtemburg Limestone, in Prof. Lesley's Slippery Rock section. See Special Report on Petroleum, (J.)

The most numerous fossils observed in it are *Spirifer cameratus*, *Productus longispinus*, *P. Nebrascensis*, *Athyris subtilita*, and *Crinoidal fragments.*

In the shales, both above and below it, occur the *carbonate ores* which were mined at several places along the Big Beaver and used at the Homewood furnace

South from the Old Furnace this limestone disappears, having apparently been cut away by the immense development, in that direction, of the overlying Piedmont Sandstone.

The shale interval, No. 2, Fig. 23, contains, at Homewood station, another small coal 60 feet below the base of the Piedmont sandstone It is only 6″ thick, and is a kind of impure semi-cannel.

These shales, No. 2, which separate the Piedmont and Connoquenessing Sandstones, are of a bluish black cast, and vary much in thickness At Homewood, they are 80 feet thick, while at the mouth of the Connoquenessing, they are only 20. They seem to increase to the south, for in the borings at Beaver Falls, they are 100 feet thick.

The Connoquenessing, (Lower Homewood), (Massilon?) Sandstone=Lower Pottsville Conglomerate, No. XII

At Homewood Station there is seen rising from the Bed of the Big Beaver, a very hard white massive sandstone, its top being at that point 18 feet above water level. As we ascend the Big Beaver, it rapidly rises and soon cuts away 60 feet of the shale interval No 2, seen at Homewood, and at the mouth of the Connoquenessing its top is 110 feet above water level, and its base a few feet below.

Followed up the Connoquenessing it is seen well exposed along the deep gorge of that stream, and consists of a massive upper and lower member, separated by shales.

(*a.*) The upper member forms the top wall of the Connoquenessing, to Hazen's mill, where it sinks beneath the stream. At the mouth of Slippery Rock its base is 10 feet above water level, and at Wurtemburg its top is at the level of the stream. Along this line it is a very massive stratum, tolerably coarse grained, very hard, grayish white, and weathering reddish on exposed surfaces. It varies little in thickness, being generally from 45 to 50 feet.

(*b*) The shales below are persistent along the Connoquenessing to the mouth of Slippery Rock, above which they soon pass below water level.

At their top we frequently see a small stratum of iron ore, or a bed of nodules. A few feet below the top comes a bed of bituminous shale, which is tolerably persistent along the Connoquenessing, and sometimes it contains a thin coal seam. A few rods above the mouth of Slippery Rock, on the right bank of the Connoquenessing, the following section may be made at this horizon.

1. Bituminous slate,	1′
2. Coal,	4″
3 Bituminous slate with coal,	6″
4. Fire Clay and sandy shales,	7′
5. Black fissile slate,	1′ 6″
6 Streak of impure coal,	2″
7. Fire Clay to bottom of creek,	2′

At this locality I noticed numerous specimens of *Sigillaria tesselata*, and *S dentata* in No 3 of this little section.

The lower part of this shaly member (b) is sandy and of a grayish color. The whole mass is usually about 40′ thick.

(*c*) The lower member (c) of the Connoquenessing sandstone is seen along the bed of the stream, from its mouth up to 1½ miles above Jones's bridge, when it passes under and is seen no more It is quite massive, and forms the lower wall of the stream for some distance. It is a coarse grayish-brown rock, and shows much false-bedding, and contorted structure. Its base is lifted above water level at only one locality on the Connoquenessing, and then the rock is seen to be 20 to 25 feet thick

These three strata, *a*, *b*, *c*, of the typical section, represent the Massillon Sandstone of Dr. Newberry.

The Sharon Coal bed.

One mile above Jones' bridge, on the Connoquenessing, a sharp roll in the strata throws the base of the last described rock a few feet above water level, and below it we see the following:

1. Bluish shales containing fossil plants,	2′
2 Stratum of iron ore,	1′

3. Dark shales containing fossil plants and *streaks of coal* near their base, seen down to water level, ... 4′

Shales 1 and 3 of this section are crowded with plant remains, which are identical with those seen in the roof shales of the Sharon coal, on the Shenango and Mahoning. Here appear immense quantities of *Cardiocarpa*, *Trigonocarpa*, and *Cordaites*, also *Odontopteris neuropteroides*, *Alethopteris grandifolia*, *A. lonchitica*, *Sphenopteris macilenta*, and numerous others. The shales themselves have the same lithological character as those over the Sharon coal, and if both were thrown on the dump together they could not be distinguished in any manner.

The streaks of coal at the base of No. 3 represent the Sharon coal, or at least its roof, though there is doubtless no workable bed at this locality.

For a fuller discussion of the Beaver River group the reader is referred to my report on the Ohio line.

Total Thickness of the Strata exposed in the District.

Recapitulating the different series as exposed within the District, we find their individual and total thickness to be approximately as follows:

Upper Productive Coal Series, . .	50 feet.	
Lower Barren Measures, " . . .	600 "	
Lower Productive Coal, " . . .	325 "	
Beaver River Series, ...	225 "	
Total thickness of exposures, ...		1,200′
Interval between the Pittsburg Coal and Sharon Coal,		1,150′
Interval between the Upper Freeport and Sharon Coal,		550′

Contribution to Palæontology from the Museum of the Second Geological Survey of Pennsylvania By Charles E. Hall. (Read before the American Philosophical Society April 6, 1877.)

GENUS EURYPTERUS

Eurypterus, Dekay, Annals of the Lyceum of Natural History of New York, 1825, Vol I, p 375

The geological horizon of Eurypterus has heretofore been confined to the Water-lime group, in the United States, although the genus has been recently discovered in the English coal measures

The position of the Water-lime group is between the Onondaga salt group and the Lower Helderberg group, therefore Upper Silurian.

The Water-lime group in Pennsylvania is lithologically well defined, but has not yet, to my knowledge, furnished a single specimen of crustacea. In New York the group is characterized by the crustaceans Eurypterus, Pterygotus and Ceratiocaris (See New York *Palæontology* Vol. III)

EURYPTERUS *Pennsylvanicus* (provisional. n sp.).

In the collection of 1874, made under the direction of Mr. J. F. Carll, in Venango County, Pa., a perfect but indistinct carapace of an Eurypterus was found by his assistant Mr Hatch

The specimen agrees in general with *Eurypterus remipes* of the Water-lime formation of the New York geology

Position and locality, in sandy shale overlying a sandstone, equivalent to the Garland Conglomerate, at Rooker Farm, Venango county, Pa

The horizon is in the transition series between the base of the *Carboniferous* and the top of the *Devonian*. (*Bernician* System of England)

EURYPTERUS —(Sub-genus DOLICHOPTERUS.)—DOLICHOPTERUS *Mansfieldi*. (n sp.)

Carapace semioval, wider than long, indented line visible along the anterior margin, lateral margins nearly straight for one fourth the length, then evenly rounded, eyes prominent, kidney-form, situated a little forward of the center of the carapace and about midway between a medial line and the lateral margins.

Body convex, the middle of the thorax slightly wider than the carapace, length of the joints increasing towards the terminal spine-like prolongation.

Entire surface covered by small, triangular, imbricating scales, decreasing in size towards the lateral margins, along the anterior portion of the carapace the scales are not visible The paletti (one of which is preserved) long and narrow, being nearly twice as long as wide, and has the characteristic serrated margin, which is the principal distinguishing feature in the sub-genus. Length of specimen, without terminal joint, two and three fourths inches; greatest breadth, seven eighths of an inch.

Position and locality. Found in the shale immediately below the Darlington cannel coal, near Cannelton, Darlington Township, Beaver Co., Pennsylvania. Horizon, Allegheny River Series, Lower Productive Coal Measures.

We are indebted to Mr I F. Mansfield, of Cannelton, for this beautiful specimen, and after whom we deem it proper to name the species.

PART III.

DETAILED OR TOWNSHIP GEOLOGY.

CHAPTER VIII.

BUTLER COUNTY.

1. Cranberry Township.

This is the extreme south-western corner of the county, and is bounded on the west by Beaver county, south by Allegheny county, east by Adams township, and north by Jackson. It is drained by Brush creek which flows through its south-west corner in a sluggish, sinuous stream. The valley of Brush creek in this township is very broad and somewhat level, owing to the softer nature of the strata composing it. The surface rocks of the township belong, with the exception of a small area on Brush creek at the extreme south-west, exclusively to the Lower Barren Series, and as these seem to be more yielding here than usual, we get no steep hills nor good exposures, but everything is deeply buried under debris.

Just before Brush creek passes out of this township into Beaver county, the *Upper Freeport Coal* is seen along its bed for the first time in decending the stream. It is mined at Graham's mill, and gives us the following section: (Fig. 25)

1. Massive Sandstone, Mahoning, exposed for			10′ 0″
2 Upper Freeport Coal,	1. Coal,	1′ 6″	3′ 4″
	2 Slaty coal,	1′ 0″	
	3 Coal,	10″	
3. Fire Clay,			5′ 0″
4. Freeport Limestone in bed of Brush creek, seen,			3′ 0″

This coal has been mined for a long time by Mr Graham, and is a pretty fair coal, though containing too much sulphur for smiths' use. It is quite variable in thickness, as the Mahoning sandstone forms its immediate roof. The miners say it often thickens up to 5 feet, and as rapidly thins away to not more than one. The limestone below it is quite compact, and contains considerable iron. The foundation of the mill is built on it. The coal goes under Brush creek here at the dam, and is seen no more in ascending it. The same coal is also mined on a little run coming in just below, by Mr. Matthew Graham, but the section there does not differ materially from that already given.

Brush Creek Coal.—About three miles above Graham's mill a small coal has been largely mined for local supply in the neighborhood. The principal mines now in operation are Emerick's and Hain's. It occurs 8′—10′ below a limestone, and the section at Mr. Hain's bank is as follows: (Fig. 26.)

1. Limestone, Brush creek,	1′ 0″
2 Dark shales,	10′ 0″
3. Coal, Brush creek,	2′ 6″

Brush Creek Limestone.—The limestone, which I have so named, is the same which occurs above what was last year wrongly identified as the Elk Lick coal, in Southern Beaver. It is a dark sandy limestone, and breaks with a slaty fracture It is fossiliferous, and in it *Chonetes mesoloba* occurs in large numbers. I have called it the Brush creek limestone from this locality. The shales below it are quite dark, and often contain streaks of coal.

The *Brush Creek coal* is somewhat slaty at the top and also at the bottom, but near the center is 15″ of very fair coal, being used for smithing, and reported to be quite satisfactory for that purpose. The bed is much cut up by "clay veins," and is also very changeable in dip, lying in rolls. It is here 65 feet above the level of Brush creek. Mr. Emmerick, just south-east of Mr. Hains', has also mined this coal quite extensively, and the section there is as follows: (Fig. 27.)

1. Limestone, Brush creek,			1′ 6″
2. Shales, dark,			8′ 0″
3. Coal, Brush creek,	1. Coal, slaty,	8″	2′ 6″
	2 Coal, good,	1′ 4″	
	3. Coal, slaty,	6″	
4. Fire clay, sandy,			5′ 0″

Sometimes the upper and bottom layers are both good coal, as well as the middle, but as a general thing they are slaty.

On the opposite side of the stream, this coal is mined by Mr. Vandever, and also by Mr. Krebs. On Coal run, one mile from Brush creek, it was once opened by Mr. Hartzell, where it was only 18″ thick, and was abandoned. One mile further up Coal run it was once mined by Mr. Roan, where it is reported to have been 2 feet thick Although this is a small coal, it is yet of much importance to Cranberry township, since, with the exception of the small area of the Upper Freeport on its extreme western edge, it is the only coal accessible. In the northern and western parts of this township everything is covered up with the easily disintegrating Barren Shales, and there is very little of interest in any portion of it.

2. *Adams Township, Butler County.*

This lies immediately east from Cranberry and like it is occupied entirely by the Lower Barren Series except near its northern border where Breakneck cuts down below the Upper Freeport Coal just as it enters the township. The township is drained by Breakneck, which flows nearly through its center. The fall of this stream is very slow; and as the Barren Series here, as in Cranberry, contains no massive sandstones, we have a broad level valley along the creek with sloping hills on either side, which renders it a fine farming and grazing country. Just at the township line, the *Upper Freeport coal* is mined along Breakneck creek by Mr. Marborough where it shows the following section: (Fig. 28.)

1. Shales,			?
2. Cannel coal,	Upper Freeport,	4″ to 6″	2′ 6″
3 Coal,		2′ 0″	
4. Concealed to Breakneck,			5′ 0″

Here the coal has a thin layer of cannel coal at the top. It is said to burn quite well and does not contain a very large per cent. of ash. The main bench, No. 3, is a very good coal, being quite black and shining and containing much less sulphur than usual. It is highly valued for domestic purposes. The *Freeport Limestone* occurs below the coal and was found in the drain, as I was informed by a man who dug it, 3′—4′ below the coal.

As we pass up Breakneck from this point the Upper Freeport coal goes under the stream one fourth mile above the township line and is seen no more within it, since the surface is occupied as previously stated entirely by the Lower Barren Series. In the hill above Mr. Marborough's opening, Mr. Dunbar once opened the *Brush Creek coal*, 70′ above the Upper Freeport. It was only 18″ thick, but said to be quite a good coal. One mile above this, on the land of Mr. Davis, the Brush Creek coal is mined, where we see the following section: (Fig. 29.)

1. Sandy shales,			10′ 0″
2. Coal, Brush Creek,	1 Coal,	8″	1′ 9″
	2 Slate,	1″	
	3. Coal,	12″	
3. Fire clay,			3′ 0″
4. Concealed to level of Breakneck,			45′

Here the upper part of the coal is rather impure being somewhat slaty, but the lower bench is a very fair coal, and though quite thin, rarely exceeding 20″, it is considerably mined for local supply. The Upper Freeport coal is about 15′ below the level of the stream One mile above this the Brush Creek coal has been mined on both sides of Breakneck, Mr. Davidson having an opening on the right bank and Mr. Hayes, on the left. They are now both abandoned, but the coal is said to have been quite good, and varied in thickness from 14″ to 20″. It is here 25′ above the level of Breakneck.

Passing up Breakneck from this point, the Brush Creek coal soon passes under it, and we see no more coal or exposure of any kind along the stream until we come to Park's mill. Here we find the *Bakerstown coal* mined one half mile east from the mill and descending from the summit of the hill above it we see the following: (Fig. 30.)

1. Concealed,	10′
2. Crinoidal limestone,	2′
3. Red shales and marls,	25′
4. Concealed,	60′
5. Coal, Bakerstown,	6″ to 3′
6. Concealed to level of Breakneck at Park's mill (1000′ above tide),	100′
7. Flaggy sandstone, seen in bed of creek.	

The *Green Crinoidal Limestone* occurs at the summit of a high knob. It is as usual filled with fossils, among which are many crinoidal fragments, and it has the same peculiar look and composition which distinguish it everywhere. It is found on another knob just east from this, and as we pass south toward Allegheny county it is caught on all the higher knobs, but strange to say it has never been burned in but a single instance so far as I could learn

Lower Barren Measure Red Clay Shales.— The red shales below it make a red band around the summit of the hill, on which neither grass nor anything else will grow to any extent.

The *Bakerstown coal* is here mined by Mr Park who discovered that he had coal at his very door, only two years ago He had hitherto been hauling his coal a distance of 8 or 10 miles for 30 years. There was a broad band of coal smut in the road before his house, and it finally occurred to him to explore it for coal, which he did with a most satisfactory result, as he now has not only coal for his own use, but plenty for his neighbors, and it brings him in a handsome income, since he can sell it at almost his own price on account of the scarcity of coal in this township This is only one instance of what might often occur, and should teach farmers to be more diligent in exploring any localities for coal where there is anything like a large blossom visible; for in the Lower Barrens the coals are not persistent, and may come in at any time. It will take only three or four days to open up any of these coals, so as to determine what there is, and if a workable bed be found the farmer is amply repaid, and if not workable he has lost very little time and gained the satisfaction of knowing at least that he has no coal.

The Bakerstown coal, as mined by Mr. Park, is quite irregular. In the thickest places it is 3′, but on going in certain directions, it rapidly runs down to 1′, and would, doubtless, very soon run out altogether if followed far in that direction. It is a very fair coal, and is preferred to the Upper Freeport for domestic purposes. It is lustrous, and some portions are beautifully irised. It contains rather too much sulphur for smithing purposes. The miners state that in some portions of the bank the coal is a perfect network of "clay veins" The sandstone seen in the creek at the mill, may be a part of the Buffalo Sandstone The Upper Freeport coal would there be about 100′ to 125′ below the level of the creek.

Glade creek enters the eastern border of this township near its middle, and flows northward along its edge. Half a mile above, where the east branch of Glade creek comes in, it cuts down and exposes the *Upper Freeport coal*, and the first exposure is at Mr. Loyd's where, at a new opening, we see the following: (Fig. 31.)

1. Sandy shale,		5′ 0″
2. Coal,	(Upper Freeport)	2′ 1″
3. Fire clay, seen,		1′ 6″
4. Concealed to creek,		8′ 0″

Here the coal is quite slaty and impure, and also contains much sulphur. Just below this, it was once mined on the land of Mr. Spence, and a large amount of coal was then taken out, but the mines are now abandoned. One fourth of a mile below, where the road crosses the east fork of Glade creek, the coal is seen at the road-side just above the forks of the stream. It is there 10′ above the creek and the *Freeport Limestone* is seen below it on the land of Mr. Loyd, where it was once burned. It contains much iron and does not slack well.

Near the northern border of this township, the *Crinoidal Limestone* is caught in a high knob on the land of Mr. Stoup.

Between the head-waters of Glade and Breakneck, the Crinoidal limestone is seen finely exposed in the road on the land of Mr. Hill, where it has once been burned.

3. Middlesex Township, Butler Co.

This township lies directly east from Adams and south from Penn. It is drained by the east and south branches of Glade creek, and by one branch of Bull creek, which heads up in its south-eastern corner The rocks exposed in this township are the same as those in Adams. The highest stratum occurring in it is the *Crinoidal Limestone*, though the *Morgantown Sandstone* is seen in some stray blocks, which still remain below their true horizon. Near the head of the south branch of Glade creek, not far from the Allegheny county line, the *Bakerstown coal* has been mined by Mr. Mowry, at whose opening we see the following. (Fig. 32.)

1. Bituminous shales,		2′ 0″
2 Impure cannel,	Bakerstown Coal,	6″
3 Shale,		1″ to 1′ 0″
4. Coal,		1′ 6″
5 Fire clay, seen,		1′ 6″

The coal is double here, having some cannel at the top, and a shale below, which varies at the mouth of the bank from 1″ to 1′ in a very short distance; when followed into the hill, the coal thickens up to 2½ feet, and has there very little slate in it. It has been mined along the little run quite extensively by stripping. The Crinoidal Limestone is seen in the hill along the road, and 80′ above the coal On the other branch of this stream we see the following section, on the land of Mr. J. Hays: (Fig. 33.)

1. Concealed,		75′
2. Coal, ... (Elk Lick,)	Berlin group,	2′
3. Concealed,		30′
4 Limestone, (Crinoidal,)		1½′
5 Red and variegated shales,		20′
6. Concealed,		60′
7. Coal, ... (Bakerstown,)		2½′

The *Elk Lick coal* was here opened by Mr. Hayes at one time, and he followed it into the hill for several yards, but being near the surface, it was quite rotten, and came out too fine, so he abandoned it. He reports it as being 2′ thick. The Crinoidal limestone is seen in a line of blocks over the surface at the horizon we have placed it, though it was not seen in bed. However, it cannot be more than 4 or 5 feet out of the way in either case, as the red clay below is quite well exposed.

The *Bakerstown coal* has also been mined here by Mr. Hayes, but the opening is now abandoned. He reports it as running about 2½ feet thick, while at some points it is as much as 3 feet. It was quite slaty, and even worthless, in some portions of the mine, but in others it was tolerably pure and good.

One mile north from here the Bakerstown coal was once opened by Mr Gilliland, but being quite impure, and only 2′ thick, was not followed into the hill. Near Hayes' mill we get the following section in descending from a high knob, one half mile to the south: (Fig 34)

1 Crinoidal limestone in scattered blocks on summit of hill.	
2. Red shales,	20′
3. Concealed,	60′
4. Blossom of coal, large, (Bakerstown,).	
5 Concealed,	90′
6. Blossom of coal, or coaly shale,	
7. Concealed,	60′
8 Massive sandstone to level of creek at Hayes' mill,	10′

The *Crinoidal Limestone* is seen on the very summit of the knob in scattered blocks, which possess the peculiar greenish-black cast and structure which is so characteristic of this rock. It is filled with fossils as usual. The smut of a coal is seen in the road 80′ below the limestone, which would make it the Bakerstown. It blackens the surface for several feet, and may be of available thickness. No. 7 is probably the representative of the Brush Creek coal. No. 8 is the top of the Mahoning Sandstone, in all probability. It is quite massive, and has been quarried here at the mill. The Upper Freeport coal should be found at 75′ to 80′ below the creek level at Hayes' mill.

Scattered over the hill, almost from the top to the bottom, are huge blocks of a massive sandstone. These are remnants of the *Morgantown Sandstone*, a rock which comes 60′ to 75′ above the crinoidal limestone. Its horizon is, of course, eroded here, as the limestone is the highest rock in the vicinity; but the massive blocks have resisted decay, and still remain at a much lower level, as monuments of the excessive erosion to which these strata have been subjected. The rock is very massive, and has been quarried extensively for building stone from the detached masses which cover the surface.

In the south-eastern corner of the township the *Upper Freeport coal* goes under Bull creek, just as the stream leaves the township to enter Clinton. The coal is also exposed for a short distance along the east branch of Glade creek, above its mouth, but is quite thin, and no openings have ever been made in it

In the eastern part of the township, about 1½ miles from Glade mills, on the land of J. B Mahan, a very deep boring was made by Charlės E. Hart, who kindly furnished me with the following record of it: (Fig. 35.)

Mahan Farm Oil Well Record.
(*By Charles E. Hart.*)

1.	Conductor hole,	12′	
2	"Bluff sand" at	75′	
3.	Coal, 4′, at [*? Upper Freeport Coal*]	200′	
4.	Coal, 2′, at	290′	
5	Limestone (?), 20′, at	300′	
6.	Sandstone, 60′, at	400′	
7.	Coal and coaly shales 8′, water and gas at	640′	
8	Cased in slate and limestone at	665′	
9.	Hard sandstone, variegated 90′, at	675′	
10.	Sandstone 100′, at	1,150′	
11.	Sand black, with brackish water, at	1,340′	
12.	First oil sand 50′, at	1,350′	
13	Slates,	70′	to 1,420′
14.	Very white sandstone, amber oil, 5 barrel well,	60′	" 1,480′
15.	Slate,	15′	" 1,495′
16.	Red rock,	10′	" 1,505′
17.	Slate,	10′	" 1,515′
18.	"Boulder sand,"	20′	" 1,535′
19.	Slate, (1,623,)	38′	" 1,578′
20.	"Stray," or "corn meal" sand,	23′	" 1,596′
21.	Slate, (1,647,)	1′	" 1,597′
22.	Sand,	5′	" 1,602′
23.	Slate, (1,690,)	38′	" 1,640′
24.	"Pink pebble" sand,	24′	" 1,664′
25.	Slate,	8′	" 1,672′
26.	Sand, at 1,732′ big gas vein; 10 bbl. oil well at 1,745′,	23′	" 1,695′
27.	Shales and slate,	40′	" 1,735′
28	White pebbly sandstone,	17′	" 1,752′
29.	Slate,	28′	" 1,780′
30.	Shales and sand,	10′	" 1,790′
31.	Blood-red slate to bottom of hole at 1,980′,	90′	" 1,880′

This is a noteworthy record, as previous borings had not found *red slates below the oil sand group.* Mr. Hart is a very intelligent gentleman, and he states that from No. 12 down he took charge of the drilling in person, and kept the record with the utmost accuracy, carefully measuring and examining each stratum With regard to the rocks in the series, No. 3 is, without doubt, the Upper Freeport coal. No. 12 is the first oil sand No. 14 is the second oil sand From No. 18 to No. 28 we get a series of sands which appear to be at the horizon of the third oil sand, and may represent that rock split up into several portions. No. 31 is represented to be a soft, argillaceous shale, and almost blood red on coming up. This stratum was not passed through, and the well was stopped in it at 1,930′. The same man states that he drilled 200′ in these red shales at Butler, without passing through them. *

4. Clinton Township, Butler Co.

This township lies directly east from Middlesex and south from Jefferson It is drained by several streams, as the great water-shed between the streams flowing west into the Conoquenessing and those flowing south into the Allegheny passes through the center of this township. The Brady's Bend Axis passes diagonally across this township, entering it one half mile south from its northern line, and passing out of it one mile east from its western line. The economic importance of this axis to this township is very great, since it brings up the *Upper Freeport coal* on all the streams which it crosses, and thus keeps that coal exposed over the entire southern part of the township North and west from the Axis the rocks belong exclusively to the Lower Barren series. On Lardin's branch of Bull creek which puts into the main stream below Millerstown, in Allegheny county, the Upper Freeport coal rises above its surface just at the Allegheny county line, and there we have the following section at Mrs. Blackstock's drift: (Fig. 36.)

1. Sandy shale, ...			5′
2 Coal, . . (Upper Freeport,)	1. Slaty coal,	1′ 4″	4′ 8′
	2. Coal, good,	2′ 11″	
	3. Slate,	½″	
	4. Coal,	4″	
3 Fire clay, seen, . .			2′

---

* [As the added measurements do not tally with the figures given in the text of this record, it is unsafe to draw any conclusions from it, until it is carefully compared with the records of many other wells. See volume of Oil Well Records published in September, 1877, as Prelude to Mr. J. F. Carll's Second Report of Progress, I.I.—*J. P. L*]

The upper part of the coal is quite slaty, and only a part of it is mined. The main bench, however, is tolerably good, though containing some sulphur, probably too much to make it available for smithing. The lower, or "Brick" coal, as it is called, is quite good and comes out in regular blocks resembling bricks A short distance above this, the coal is also mined by Mr. S. Hemphill, but it shows about the same structure as that just given. It rises very rapidly as we ascend the stream, and one mile above the Allegheny county line the same coal is mined by Mr. Joseph Hemphill, at whose drift we get the following section: (Fig 37.)

1. Coal, ...		4′ 0″
2. Fire clay, ...		3′ 0″
3. Limestone, . . (Freeport,)	1 Limestone, . . 2′ 2 Shales, 4′ 3. Limestone, . 2′	8′ 0″
4. Sandy shales to level of Bull creek, ...		25′ 0″

Here the *Freeport Limestone* is in two layers with 4′ of sandy and argillaceous shales separating them The upper one is quite compact, and breaks with a clear, sharp fracture, while the lower one is very ferruginous and almost an iron ore.

At Mr Morris's drift, ½ mile above, we have the following section of the same coal bed: (Fig. 38.)

Upper Freeport coal, .	1 Slaty coal,	1′ 0″	5′ 0″
	2. Coal, good,	3′ 3″	
	3. Slate,	1″—½″	
	4 Coal,	5″	
	5. Slate, .	1″	
	6. Coal, . .	2″	

Nos. 4 and 6 are quite impure and are not taken out The slaty portion at the top is never mined but is left for the roof.

As we ascend the stream, the next opening of any importance is one half mile below Lardintown, where Mr. Grinder mines the coal extensively for local supply. The section there does not differ materially from the last, except that the main bench is only 3′ thick. The coal is here 40′ above the stream and the north-west rise very rapid.

Lardintown Gas Well.—About one fourth mile above this occurs the great gas well from which gas is conveyed in a pipe to the Ætna furnace at Sharpsburg and used in the rolling mill. No record could be obtained of the rocks passed through, but it was learned that the gas was struck at a depth of 1,155 feet. The top of the well is 35′ below the Upper Freeport coal which makes it 1,190 feet from that stratum, and this puts it in the first oil sand.

Just east from this one fourth mile a well was commenced at a surface level of 125 feet above the Lardintown well and bored to the depth of 1,772′. It struck no gas of any importance until the bottom was reached, when a very large supply was obtained. It was not so strong as the Lardintown well however. This last is in the Third sand.

Just below the mill at Lardintown the Upper Freeport coal is extensively mined by Mr. John Lardin where we see the following section: (Fig. 39.)

1. Shales,		5′
2. Slaty coal,	Upper Freeport Coal,	1′ 0″
3. Coal,		3′ 0″
4 Slate,		½″
5. Coal,		6 ″
6. Fire clay,		4′
7. Limestone,	Freeport,	?

The coal is quite good and is hauled from here a long distance to the north and north-west where the coal is below them. The limestone was not seen below the coal but is reported by one of the miners to occur in a drain 4′ below the coal. Just above, the *Mahoning Sandstone* is seen quite massive.

The rise of the rocks towards the north-west is about 250′ to the mile.

Just above Lardin's mill the coal is opened for the last time on this branch of the stream, and at Mr. Holstead's drift we get the following section: (Fig 40)

1. Shaly sandstone,			15′ 0″
2. Sandy shales,			15′ 0″
3. Upper Freeport coal,	1. Slaty coal,	1′ 5 ″	4′ 4″
	2. Coal,	2′ 6 ″	
	3. Slate,	½″	
	4. Coal,	5 ″	
4. Fire clay and shales,			5′ 0″
5. Limestone seen in bed of creek,			3′ 0″

The strata are rising very rapidly to the north-west; but the stream exceeds the coal and the latter passes under water level just above Mr. Holstead's opening. The Fifth Axis crosses the stream a few rods above this point.

Here coping the hills 100 feet above the coal we discover the massive *Buffalo Sandstone* which is a regular conglomerate, some portions of it being a mere mass of pebbles. Its huge out-liers are scattered over the surface in every direction.

Crossing over the divide to the Montgomery's branch of Bull creek we may find the *Upper Freeport Coal* mined in several places along this stream. The Fifth Axis crosses this stream opposite Mr. J. Montgomery's, one and three fourths mile north from the Allegheny county line. Here it throws the coal 70′ above the creek; but the dip changing to the north-west on the west slope of the Axis the coal runs under one half mile above where the Axis crosses, on the land of Mr McGregor, or rather just at his line. He once opened the coal; but the dip was so rapid to the north-west that the bank could not be drained and was abandoned A short distance below this the coal is extensively mined by Mr. Woods, at whose opening we get the following section: (Fig. 41.)

1. Shaly sandstone, ...			2′ 0″
2. Slaty coal,	Upper Freeport Coal,	2′ 4″	5′ 7″
3. Coal, good,		2′ 9″	
4. Slate, . .		½″	
5. Coal, . . .		6″	
6. Fire clay, ...			3′ 0″
7. Limestone, Freeport, ...			2′ 0″

Here the roof division is much thicker than usual. It is a hard, slaty, bony coal, and is not mined. No 3 is quite good, being hard, lustrous, and quite rich in bituminous matter. The only fault it has is too much sulphur

The *Freeport Limestone* has been cut down into in digging a drain. It is a light dove color, very compact, and somewhat brecciated. Minute fossils are seen in it here of unknown affinities. One is a univalve, and the rest look like bivalve crustaceans.

A short distance below this, at an opening which is now abandoned, the coal is reported to be 8′ thick, and to show the following section: (Fig. 42.)

1. Coal,	Upper Freeport Coal,	4 ′
2 Shales,		1½′
3. Coal,		4′

The lower bench was mined for several years before the existence of the upper one was known, when a fall of the roof exposed it. The upper portion was not so good a coal as the lower, being more slaty and impure. This is a return to the structure of this coal as exhibited along the Allegheny river, below Tarrentum, where it shows almost a similar section.

The *Freeport Limestone* is here again seen below the coal along the creek in huge blocks where it has slipped down from the bank above. *The Butler Sandstone*, a massive, hard brownish stone comes in 15 to 20 feet below the coal a short distance down the creek

Mr. J. Montgomery has the last opening in the coal as we descend this branch of Bull creek. The coal dips quite rapidly to the south, and is accessible all along the stream in this county, but there are no more openings until we pass south into Allegheny county. The west branch of Bull creek puts into the Montgomery branch, near the Allegheny county line. Passing up the west branch there are no openings in the coal until we get two miles above its mouth, when we find it mined on a small branch of this stream which comes in from the south by Mr. Niess, and here we get the following section: (Fig 43.)

1. Sandstone, seen,		2′ 0 ″
2. Shales,		1′ 6 ″
3. Coaly slate,	Upper Freeport Coal,	6 ″
4. Coal,		2′ 5 ″
5. Slate,		½″
6. Coal,		4 ″
7. Fire clay,		2′ 6 ″
8. Limestone,	(Upper Freeport,)	2′ 0 ″
9. Concealed to creek,		25′ 0 ″

The *Mahoning Sandstone* is here quite massive and frequently cuts the coal out entirely, as I was informed by Mr Niess. This is near the Allegheny county line Only a few rods east from Mr. Niess's the Brady's Bend Axis crosses the creek and passes into Allegheny county. Going on west from this, up the main west branch, we find the coal passing under the stream, near the line of Middlesex township. The Lower Barrens cover the entire portion of Clinton township, north from the center, and as everything is there concealed very little can be said of it. The Brady's Bend Axis brings up the *Upper Freeport* coal just at the north-eastern edge of this township, on Sarver's run, but none of the banks worked there are on this side of the line.

Oil Wells.—Mr. C. E. Hart has drilled two oil wells in this township, about two miles south from its northern border on Jefferson township.

The Chantler well, No. 1, commences 200′ above the Upper Freeport coal. A heavy vein of gas was struck at 1,340 feet, which makes it the first oil sand. The gas is conveyed to the Ætna furnace, near Pittsburg.

Another well on the Westerman farm, just south from the Chantler well, struck the first sand at 1,340 feet, and the record from it is as follows: (Fig. 44.)

1. First oil sand, struck at 1,340′,	40′
2. Shale,	65′
3. Second oil sand, white and pebbly,	50′

They were in the last sand when I visited them. Gas was obtained in the first sand and some oil in the second.

5. *Buffalo Township, Butler County.*

This lies directly east from Clinton and south from Winfield, and its south-eastern corner touches the Allegheny river at Freeport. Big Buffalo creek flows along its eastern border, while Little Buffalo passes through its center, Sarver's run being the principal branch of the latter stream. The southern portion of the township is drained by the waters of Little Bull creek

The Buffalo SS. and Mahoning SS.—The bottom sandstones of the Barren Measures reach their greatest development in this township, each one having an average thickness of 60 to 70 feet, and, as the two Buffaloes cut down through both, we find their channels perfect gorges with these massive conglomerates, forming a double line of cliffs on either side, and making the scenery very wild and picturesque.

The Upper Freeport coal, at the mouth of Big Buffalo, is 140′ above the Allegheny, and, as we go north up Big Buffalo, is constantly above that stream, although the rise of the stream bed is very rapid. Along Little Buffalo it keeps above water level until we get one half mile above Monroe station, or near the mouth of Sarver's run, where the very rapid rise of the stream bed surpasses the north-west rise of the coal and it passes under; but near the north-west line of the township the steeper dip, near the crest of the Fifth Axis, once more brings the coal to day-light on Sarver's run, near the line between Buffalo and Clinton townships. This is just at the crest of the axis, and the coal merely takes a peep above water level when it again plunges down to the north-west. It is exposed along the stream for only one fourth mile from where it first comes up to where it passes down. The coal is mined quite extensively here, and is the source of supply over a wide area. At Mr. Miller's drift we see the following section: (Fig. 45.)

1. Mahoning sandstone,			15′
2. Sandy shale,			2′
3. Coal, Upper Freeport,	1. Coal,	5″	4′ 3″
	2. Coal shale,	6″	
	3. Coal,	2′ 10″	
	4. Slate,	½″	
	5. Coal,	5½″	
4. Fire clay,			8′
5. Limestone, (Upper) Freeport,			2′ 6″
6. Concealed to bed of stream,			5′

The *Upper Freeport bed* is also mined here by Mr. Rieth, Mr. Krumpy, and Mr. Wilson, within a stone's-throw of each other, and the coal shows the same structure in all. The roof coal (Nos. 1 and 2) is not taken out. The main bench, No. 3, is quite a fair coal, having a very lustrous, clean appearance, and containing much less sulphur than the coal at most places. The slate parting near the middle is also seen here. The coal below this parting is not quite so pure as that above, being softer and often containing much sulphur.

The *Mahoning Sandstone* is just here not very massive, but the Buffalo Sandstone, which comes in 120′ above the coal, is very largely developed, and huge blocks of this conglomeratic sandstone lie scattered over the hill.

Descending Sarver's run, the strata dip very rapidly, and at the mouth of the stream the top of the Mahoning Sandstone is a few feet above water level. The Fifth Axis crosses Buffalo creek north from this township, in Winfield. The Buffalo Sandstone forms a huge cliff all along this stream, and its huge blocks are filled with quartz pebbles, many of them as large as hickory nuts.

The *Upper Freeport coal* comes out of the creek one half mile above Monroe station, and is seen along the railroad cuts, with the Mahoning resting directly upon it It varies from 1 to 3 feet in thickness along the railroad track. Just above Monroe station it was once mined and shipped on the railroad, but the mines are now abandoned

At Monroeville a hill rises back of the village, 450′ above the Upper Freeport coal; and 100′ below the summit of the knob a broad band of red shale is seen, which is that under the *Crinoidal Limestone* This would make the interval here 350 feet from the crinoidal limestone to the Upper Freeport coal. Descending the little run, from the village of Monroeville to Monroe station, we get the following section of 195 feet of measures: (Fig 46.)

1. Massive conglomerate sandstone, Buffalo, seen,	30′
2. Concealed,	60′
3. Massive conglomerate sandstone, Mahoning,	75′
4. Coal, Upper Freeport,	0′ to 4′
5. Fire clay,	1′.
6. Limestone, (Upper) Freeport,	5′
7. Sandy shales to level of R. R. track at Monroe, which is here 855′ above tide,	20′

This makes the elevation of the coal about 875′ above tide. The coal is mined on the little run which puts into Little Buffalo opposite Monroe station, where it is sometimes 4′ thick and then suddenly runs down to almost nothing. This is doubtless occasioned by the erosion of the coal bed which the sandstone replaces. The upper cliff rock (the Buffalo SS) we have had constantly in sight along Little Buffalo from Delano station to this point. Here it is not fully exposed, but what is seen of it is a massive conglomerate. The Mahoning Sandstone is an enormous rock and is also conglomeratic, many of its layers containing numerous pebbles. It is seen along the stream in a perpendicular cliff and adds much to the wildness of the scenery.

One fourth mile below Monroe we see the following section: (Fig 47.)

1. Mahoning sandstone,	75′
2. Coal, Upper Freeport,	3′
3. Fire clay,	1′ 6″
4. Limestone, (Upper) Freeport,	3′ 6″
5. Sandy shales,	40′
6. Coal, Lower Freeport,	10″
7. Fire clay, seen to level of R. R. track,	3′

The *Freeport Limestone* in these sections is very hard and compact and has a yellowish brown color on its weathered surface. Passing down the creek the stream falls very fast and the massive *Freeport Sandstone* soon makes its appearance in the bed of the same, and one half mile below the mouth of Little Buffalo, on the Big creek, the *Darlington coal* comes up immediately under the Freeport sandstone and is seen to vary from 1½ to 2½ feet in thickness. Just before Big Buffalo creek passes into Armstrong county we get the following section of 328′ in descending a ravine on its right bank: (Fig. 48.)

1. Massive conglomerate, Buffalo sandstone, seen,	30′
2. Sandy shales,	65′
3. Massive sandstone, Mahoning,	60′
4. Coal, Upper Freeport,	3′
5. Concealed,	100′
6. Massive sandstone, Lower Freeport, seen,	40′
7. Shales,	5′
8. Coal, Darlington (Upper Kittanning coal),	2′
9. Fire clay,	3
10. Sandy shales to level of Buffalo,	20′

The Upper Freeport coal was once mined here but has been long since abandoned. The Darlington coal has never been mined at this locality, though it is a very pure looking coal where exposed in the cuttings along the railroad. It has a parting of slate a few inches above its base. *A subordinate Axis* probably passes across the strata here which throws up this coal, as it continues in sight for only a short distance, when it passes under the railroad track and at Freeport is below the level of the Allegheny river. The section at Freeport is given in connection with the general description (page 24), and need not be repeated here.

The *Crinoidal Limestone* is caught by all the highest knobs in the southern portion of this township along the headwaters of Little Bull creek. On the land of Mr Flemming 2 miles south-west from Monroeville, the crinoidal limestone is seen along the roadside with the red clay and variegated shales below.

The *Elk Lick coal* was once opened 35′ above the limestone, on Mr. Flemming's land, reported 2½′, but so near the surface that the roof was rotten and could not be kept up. The coal is said to have been quite good.

One half mile north from the Allegheny county line the crinoidal limestone is seen on the land of Mr. Richards.

The southern portion of Buffalo, being composed of the softer shales of the Barren Series, contains many fine farms, being quite a contrast in that respect from the portions of the same township along the two Buffaloes.

6. Winfield Township, Butler County.

This lies directly north from Buffalo, and, like it, adjoins Armstrong county.

It is drained by Little Buffalo, which flows south through its south-western part, and by Rough run in the north, and Cornplanter's run on the eastern border.

The Fifth Axis passes very nearly through its central line diagonally from the north-east corner to the south-west, crossing Rough run ¾ mile above Winfield Furnace, and Little Buffalo ½ mile below Saxonburg.

On Rough run it brings up the top of the Piedmont sandstone, but Little Buffalo does not cut down near so deeply, and, where it crosses that stream, the Upper Freeport coal is not brought up by 20 to 30 feet.

Near where Rough run enters Armstrong county from this township, we see the following section of 68 feet: (Fig 49.)

1. Massive sandstone,			10′
2. Shales containing iron ore at bottom,			10′
3. Limestone, Ferriferous (forming a solid cliff),			18′
4 Dark shales,			15′
5. Coal, Clarion,	1 Coal,	1′ 4″	2′ 8″
	2 Slate,	1″ to 2″	
	3. Coal,	1′ 8″	
6. Concealed to bed of creek,			12′

Ore.—The Winfield Co stripped the shales above the limestone for the ore, which rests directly upon the limestone. I could see nothing of its thickness, but it was reported to be from 1 to 2 feet.

The *Ferriferous Limestone* is here seen in a solid massive cliff, without a single break It is quarried and burned by Mr. McCurdy on the Winfield Furnace property. The lime from it is celebrated far and wide for its purity and whiteness.

The *Clarion coal bed* No 5 is mined by Mr. McCurdy and used in burning the lime. At the mouth of the drift it is somewhat slaty, but Mr. M tells me that this disappears on following it into the hill, and it there becomes an excellent coal. He also states that its average thickness is 3 feet, although it sometimes runs as high as 4, and as low as 2½. It is a bright, hard, clean looking coal, where seen on the dump, though containing some sulphur.

Just opposite the old furnace, we get the following: (Fig. 50.)

1. Kittanning coal,	(reported thickness),	3 ′
2. Concealed,		55 ′
3. Limestone, Ferriferous,		16½′
4. Concealed,		12 ′
5. Clarion coal, .	(reported),	3 ′
6. Concealed,		30 ′
7. Massive sandstone to the bed of creek (Piedmont), .		20 ′

The *Kittanning* coal was mined here by the Winfield Furnace company, several years ago, but the opening is now fallen in, and the coal cannot be seen. Mr. McCurdy, however, tells me that the coal was 3 feet thick, and of excellent quality, being coked and used at the furnace in smelting the ores.

The *Ferriferous Limestone* is here seen in a huge cliff all along the face of the hill. It is a pale bluish-colored rock, and crowded with fossils It was used as a flux at the old furnace. The Clarion coal was also mined here by the Winfield Company.

Of the *Piedmont Sandstone*, No. 7, only 20 feet is here brought above the water level. It is a coarse, white sandstone, very hard and massive. It forms the bed of the creek here for a short distance, and the stream has cut down through it, wearing channels in the softer portions and leaving the harder standing out in huge ridges, while immense blocks of the rock line the banks and obstruct its channel, rendering its course very wild and picturesque.

The dip of the strata is very rapid to the south-east, nearly 5 degrees in some places.

Ancient erosion of the Ferriferous Limestone. (?)—Ascending Rough run from the old Furnace, the Ferriferous Limestone is seen in a huge cliff, rising higher and higher above the stream, and can be traced around the hill to one half mile below Denny's Mill, when it *suddenly disappears* at a considerable elevation (60′—80′) above the stream, while at the same time the sandstone above it attains a development which seldom occurs with it. Here it is seen in huge masses as large as a house, scattered over the hill at the point where the limestone disappears. It is very probable that it was eroded by the current which threw down the sandstone mass, as it was found in none of the borings made near here, though an unusual amount of sandstone was found at the horizon where it should occur.

One mile above old Winfield furnace, at Denny's Mill, we get the following section in descending from top of hill along the road which leads down to the mill past the "Summit" bed of coal, and the Iron-ore mines, on the land of Mr. Denny: (Fig. 51.)

Denny's Mill Section; 255 feet.

1. Coal, Upper Freeport, ... (reported),	8′
2. Concealed, ...	50′

3.	Massive sandstone (Butler Sandstone),		15′
4.	Coal, Lower Freeport,	0′ to	2′
5.	Fire Clay,		4′
6.	Iron ore,	1½′ to	6′
7.	Limestone, Butler,		5′
8.	Concealed,		130′
9.	Smut of coal, Kittanning,		?
10.	Concealed,		30′
11	Massive sandstone to bottom of Rough run,		10′

The Upper Freeport coal, No. 1, has been opened here at the roadside, by Mr. Denny and mined to some extent, but the mine is not now in operation, and the coal could not be seen. Mr. Denny states that it is 3 feet thick, and has a limestone below it. It is called the "Summit Vein" from its occurring near the tops of the hills.

The *Butler Sandstone* is quite massive, and is seen in a solid cliff above the ore strippings. It is a coarse, reddish-brown, micaceous rock.

The *Lower Freeport coal* is reported by Mr. Denny, who worked in the ore drifts, to be quite variable; at times it runs up to 2 feet, and again thins away entirely. It is also very impure and of no economical importance.

The *iron ore*, No. 6, which largely supplied the old Winfield furnace below here, is a mixture of blue carbonate and limonite, and therefore quite rich, probably yielding from 35 to 50 per cent of metallic iron. Mr. Denny, on whose land the ore was mined, states that it varies in thickness from 1½ to 6 feet. There is iron ore at this horizon throughout all this region, and this ore has been stripped at many points. It supplied the Buffalo furnace on Big Buffalo, in Armstrong county. It rests directly on the limestone below.

The *Butler Limestone*, No. 7, is quite ferruginous, has a buffish cast, is much brecciated, and nodules of iron ore are disseminated through it. It is called the "bastard limestone" by the inhabitants, as from impurities of iron and earthy matters it will not slack on burning.

The blossom of the *Kittanning coal* is seen in the bank above the mill. It has never been opened here, as the people get their fuel entirely from the "Summit" or Upper Freeport bed.

The massive Sandstone (Lower Kittanning SS.), seen in the creek bed, is that which immediately overlies the Ferriferous Limestone, though two borings commencing above it, report no limestone from either well.

Oil Wells.—Three wells were bored for oil here to the third sand; no oil however was obtained, but abundance of gas was found at 900 feet. No records of the borings could be procured, but the following items were furnished from memory by one of the drillers:

"The first massive sandstone was struck 50 feet below the surface and was 110 feet thick, very hard and white." This should be the Piedmont Sandstone, the rock given in the section opposite the old furnace below, as occurring in the creek bed.

"The *first oil sand* occurs at 900 feet, and this is the horizon from which the gas arises. The *third sand* is found at 1,400 feet." The wells commence about 30 feet below the Kittanning coal, or 235 feet below the Upper Freeport Coal.

A short distance above the mill, Swaney's run puts into Rough run, and the *Upper Freeport* coal is mined in numerous places along either side of it, far up toward the tops of the hills. Collins' bank shows the following section: (Fig. 52.)

1. Shales.			
2. Coal, Upper Freeport,	1. Coal,	2′ 8″	3′ 2′
	2. Slate,	1″ to 2″	
	3. Coal,	4″	
3. Fire Clay,			4′
4. Limestone, Freeport,			3′
5. Concealed,			65′
6. "Summit" ore,			?

Here the coal is of an excellent quality, being very black, shining, and clean. It is reported to be quite a good smithing coal, and very probably is, as all the sulphur perceived in it was in the form of "binders," which could readily be removed. On the opposite side of the Run (Swaney's) it is mined by Messrs. Jackson, Simmons, Grier, and King, also by Mrs. Hartung. The coal is about the same thickness and quality in all the banks, and shows the same structure as that seen at Mr. Collins'.

The fire clay under the coal is of exceptionally good quality, being free from any coarse and too silicious material.

The Freeport Limestone is quite ferruginous and brecciated, and minute fossils were seen in some portions of it.

The "Summit ore," as that is called which occurs on the Butler Limestone, was once stripped out of the hill here, 70 feet below the coal, but its thickness or quality could not be learned.

Ascending the hill above Mr. Collins', we find the base of the *Buffalo Sandstone* coming in at 90 feet above the Upper Freeport coal. It is 80 feet thick, and covers the hills with huge blocks of its massive conglomerate, it being filled with pebbles.

Coleman (?) Coal.—A few feet above its top, and 175 above the Upper Freeport coal, we find quite a large coal blossom in the road. This represents the coal sometimes seen on top of the Pine creek Limestone.

On Rough run, 2½ miles above Denny's mill, the *Upper Freeport coal* is mined on the land of Mr. Peter Cypher. It is there 3 feet thick, and quite good. The Freeport Limestone is also seen below it. One mile above this it passes under the creek, and is seen no more within the township.

Passing over from Rough run to the waters of Little Buffalo, the *Buffalo Sandstone* is often seen in massive cliffs along every stream which cuts down into the measures. At Delano station, on the Butler Branch Railroad, it is just coming above the track, while at Saxon city, one mile below, its base is 75 feet above the same.

The Saxon Gas Well.—Here, at Saxon, occurs one of the great gas wells of the Butler county field. No record of it could be obtained by me, nor could I learn at what depth the gas was struck, except that it was somewhere near 1200 feet. This would put it in the First oil-sand, as the Upper Freeport coal is about 50 feet below the mouth of the well, and numerous borings through the Butler region show that the First oil-sand comes about 1,150 feet below that coal. *

One half mile below Saxon city the Fifth Axis crosses, and there the base of the Buffalo Sandstone is 100 feet above the creek, the Axis thus failing, by about 20 feet, to bring the horizon of the Upper Freeport coal to the surface.

The Buffalo Sandstone caps the hills along the railroad with massive cliffs of conglomerate, and falls faster than the creek throughout the rest of its course to the south, in Winfield township.

7. *Jefferson Township, Butler County.*

This lies directly west from Winfield, and north from Clinton. It is drained almost entirely by Thorn creek, which, rising in its northern part in several branches, flows south through the center of the township, almost to its southern line, when it turns squarely to the west, for a short distance, then veers directly north, and passes out of the township in a northwesterly direction.

There is very little of interest in this township, as its surface is occupied almost entirely by the Barren Measures, and is probably the worst off for coal of any township in the county, since the only place where any coal is workable is along the lower part of Thorn creek for only one half mile.

Here, at the western line of the township, the *Upper Freeport* is accessible, but it is quite thin, and does not amount to much It is mined by Mr. Wagner, at whose drift we have the following: (Fig 53)

1. Sandy shales,		. . . . . .	6′
2. Coal,	Upper Freeport,	2′ 1″	2′ 6′
3. Parting,		½″	
4. Coal,		4″ to 5″	
5. Concealed to creek,			15′

The coal, although thin, is quite good, and is mined to some extent for local supply

The dip is south-east, and the creek veering to the south, the coal runs rapidly down as we ascend the stream, so that at Mr. Welsh's, ¼ mile above, it is only a few inches above water-level.

---

* [For a discussion of this and other Gas and Oil wells see the forthcoming Reports I.I and I.I I of Mr. J. F. Carll —*J P L*]

Here the coal has been mined for a long time on the land of Mr. Welsh, where it is about 2 feet 4 inches thick. It occurs so near water-level that it is very difficult to drain, and the creek floods the bank at every rise. Just above this the coal passes under the creek and is seen no more.

Three fourths of a mile above Walker's fording, or where the road crosses the creek at Mr. Welsh's, a hole was once bored for oil on the land of Mr. Thomas Welsh, and the following record was kept, commencing 10 feet above the creek: (Fig. 54.)

Welsh's Oil Well Record. Well, 292½′ deep.

1.	Conductor hole,			18′
2.	Sandstone,			10′
3.	Blue Slate,			4′ 6″
4	Black Slate,			6′ 6″
5.	*Coal*,			6′
6.	Fire clay,		5′	48′
7.	Sandstone,	(Upper Freeport)	30′	
8.	Red Shale,		5′	
9.	Black Slate,		8′	
10.	*Coal*,			4′
11	Fire clay,		3′	44′
12	Sandstone,	(Lower Freeport)	27′	
13	Black Slate, partly Cannel,		14′	
14	*Coal*, Darlington,			10′
15	Fire clay,		11′	28′
16	Soft Sandstone,		10′ 6″	
17	Slate,		6′	
18	*Coal*, Kittanning,			8′ 6″
19.	Fire clay,			10′ 6″
20.	Reddish Shales,			60′
21.	Very hard White Sandstone to the bottom of hole,			52′ 6″

This remarkable record must, of course, be taken only for what it is worth, for surely *the coals are all too thick*, and possibly the driller has placed coal where there is none, mistaking black slate for coal *

The Upper Freeport Coal bed is here, near the bottom of the stream.

No 10 represents the Lower Freeport, No. 14 the Darlington, and No. 18 the Kittanning. The last is said to have been much the cleanest and purest coal, when brought up in the sand-pump.

---

* [This is a good example to illustrate the unreliability of all our oil-well records, and the difficulties thus cast in the way of a geologist who seeks to employ them profitably in his survey of Western Pennsylvania.—*J P. L*]

No. 21 is the Piedmont Sandstone, or Upper Member of the Pottsville (Seral) Conglomerate Formation No XII It was said to be very hard and as white as salt.

The horizon of the Upper Freeport would be near the bottom of the conductor hole At any rate, its horizon was passed somewhere in No. 1.

No. 5 is probably nothing but black slate with possibly a few inches of coal in it.

No. 12 is the Freeport Sandstone

No. 14, the Darlington coal, should doubtless be divided by two, and then diminished somewhat.

One half mile north from the cross-roads, between Walker's fording and Jefferson Centre, the *Crinoidal Limestone* is caught in the summit of a high knob, on the land of Mr. Goebel, and the great band of red clay under it also makes its mark in the road for some distance

At Frazier's mill, a very deep *oil well* was once bored, but I could get no record of it

The *Buffalo Sandstone* is there, 80 feet above the stream, and quite massive. As we ascend Thorn creek from this point, it gets lower and lower until the top of it only is seen above water-level at Jefferson Centre.

Representative of the Coleman Coal?—Here a thick bed of bituminous shale is seen, 80 feet above the stream, and is very probably the one which occurs 175 feet above the Upper Freeport coal, or over the Pine Creek Limestone In that case, the Upper Freeport coal would here be about 100 feet below water-level.

Passing above Jefferson Centre, the massive sandstones have all gone under, and the creek falls very gently, thus giving us a beautiful country for farming near the head of the stream, in striking contrast to the wilderness along the lower part of the same.

8. Penn Township, Butler County.

This lies east from Jefferson, and north from Middlesex. It is chiefly drained by Thorn creek, which passes diagonally across it, and enters the Connoquenessing in its northwest corner, where the latter stream comes through the township for a short distance

This township is as poorly off for coal as Jefferson, for, although the Upper Freeport is exposed along Thorn creek throughout its entire extent, it becomes workable at only one locality on the same. On the Connoquenessing, below the mouth of Thorn creek, the Upper and Lower Freeport beds are accessible at one point.

No finer exhibition of the influence of the underlying rock on the character of the topography can be furnished, than is seen along Thorn creek, from its head to its mouth. This stream rises in the northern part of Jefferson township, far up in the Lower Barren series, where the underlying rocks are soft shales, which easily disintegrate, and give us broad, level valleys, and gently sloping hills. But the descending course of the stream soon cuts down into the massive sandstones, which lie at the base of the Barren Measures. These it enters at Jefferson Centre, when the character of the topography undergoes a marked change The stream, which has hitherto been sluggish, becomes very rapid; the broad bottoms along the sides of the stream are abruptly contracted. The low, sandy banks are replaced by steep cliffs of massive sandstone, which gradually rise higher and higher as we descend the Creek, and where it enters Penn township, the Buffalo Sandstone outcrops are 120′ above its bed

From this point to the mouth of Thorn creek, this massive conglomeratic stratum shows well up in the hills, whose steep slopes it covers with a heavy coating of rocky debris, rendering them sterile, and making a perfect wilderness of the country along the stream for several miles.

Just below where Thorn creek enters Penn township, the Upper Freeport coal is mined by Mr. Alexander Welsh, at whose drift we see the following. (Fig. 55.)

1. Sandy Shales,			10′
2. Coal, Upper Freeport	1. Coal,	2′	2′ 5″
	2 Slate,	½″	
	3. Coal,	4½″	
3. Fire Clay,			4′
4. Limestone, Freeport,			8′
5 Concealed to Thorn creek,			15′

The coal is quite good, and contains very little sulphur. It is brilliant and oily, and is in high repute for smithing and domestic purposes A grate was shown to me in which the coal had been burned for thirty years, which was apparently as good as ever

As we go down Thorn creek from this point, the coal thins away.

The Freeport Limestone, under the coal, has the same brecciated, ferruginous appearance, so common to it

One mile below Mr Welsh's coal bank, Patterson's run puts into the right bank of Thorn creek, and there the *Buffalo Sandstone* is seen in a massive cliff, 140′ above the level of Thorn, while huge blocks of enormous size cover the surface of the hill down to the creek so thickly that the ground can scarcely be seen.

A short distance below the mouth of Patterson's run, Mr. Kennedy once attempted to open the *Upper Freeport* coal, but he found it only 18 inches thick. It is there 25 feet above the stream.

Just above where the old turnpike crosses Thorn creek, the Upper Freeport coal was once mined by Mr Lavery, and he reports it as 20 to 24 inches thick, with the Limestone below it, and 30 feet above the stream

On the Butler plank road, one mile south from Thorn creek, a very high knob runs up far above any others, and takes in the *Crinoidal Limestone* near its summit.

Descending from this point along the plank road to Thorn creek, the following section 455′ high is seen: (Fig 56.)

1. Concealed, but containing the Crinoidal Limestone near its top,		90′
2. Marly Shales,		10′
3. Sandy Shales,		50′
4. Coal,	(Coleman?)	1′ 6″
5. Limestone,		8′

6.	Concealed, ...	75′
7	Bituminous Shales, containing streaks of Coal, .	10′
8.	Sandstone, and concealed, ...	165′
9.	Coal, Upper Freeport, ...	. Blossom.
10.	Concealed to level of Thorn creek, . .	50′

The Crinoidal limestone comes into the section somewhere above the middle of No. 1, as the boulders of it cease above that point. It also occurs on the land of Mr. Dodd and others, ¾ of a mile south from Mr. Fisher's, and there the *Lower Barren Red Clay* is seen underlying it.

The little coal, No 4, was once opened on the land of Mr Fisher, but the dip was so sharp to the east, the only direction in which the drift could be made, that it had to be abandoned. It is reported to have been 1½ feet thick, and quite a good coal. Immediately under it comes a dark, dove-colored, fetid limestone. It contains a minute *univalve* in great numbers.

In No 6 occurs a very *massive sandstone*, since many huge boulders were seen at this horizon, which could have come from no other place

No. 7 is a dark, sandy, bituminous shale, which also contains streaks of coal, and, in some places, a small coal bed. Along the Plank road below Mr. Fisher's, some one has drifted in on it for several yards, in hope of finding a workable bed of coal. It is needless to state that black shales seldom turn into coal, however far they may be drifted upon.

No. 8 contains the massive Buffalo and Mahoning Sandstones. It is mostly covered up here by debris, though huge blocks of stone are strewn over the surface throughout the entire interval.

The *Upper Freeport Coal* has never been tested here Its blossom is quite small, however, and it is probably not more than 1½—2 feet thick.

About 10 feet above the creek, occurs the *Lower Freeport Coal*, and Mr. Kennedy has spent about $4,000 in drifting on it for coal. He has driven entries on it in every direction, sometimes he would have a few inches of coal, and again he would have none, and once it suddenly thickened to 4 feet, but as rapidly disappeared altogether In spite of all this he is not yet wholly discouraged, and even contemplates further expenditures in the same direction, as he is assured by the "practical" coal miners that "the coal is there, and will, eventually, be found, when they get under the hill past the '*slip.*'" It can be stated with the fullest confidence that Mr Kennedy will never find any workable coal at that horizon should he drift on forever, since the Lower Freeport is workable at but three or four localities in the entire district Had the same amount of capital been expended in shafting to the Darlington coal, he would have had to-day a good bed of coal at his command; for that coal could be reached here at 80 to 100 feet below the bed of the stream

At the mouth of Thorn creek the Upper Freeport coal is 50 feet above the level of the Connoquenessing, and the base of the Buffalo Sandstone comes 100 feet higher The hill and valley is covered with massive fragments of this stratum.

A short distance below the mouth of Thorn creek, on the land of Mr. Renfrew, we have the following section, descending 200 feet to the Connoquenessing creek at a point below the mill: (Fig. 57.)

1	Coal,	(Coleman Coal?)	8''
2	Concealed,		40'
3	Massive Sandstone, Buffalo,	seen,	20'
4	Concealed,		100'
5.	Coal, Upper Freeport,		2'
6.	Fire Clay,		5'
7.	Limestone, Freeport,		3'
8.	Concealed,		45'
9.	Coal, Lower Freeport,		2' 2''
10.	Concealed to creek,		2'

Coleman (?) Coal —A small coal above the Buffalo Sandstone occurs at the base of bituminous shales, and Mr. Renfrew drifted upon it for several rods. It failed to thicken up, however. It probably represents the bituminous shales and coaly material seen in sections along the plank road, at Mr. Fisher's.

Only a part of the Buffalo Sandstone is seen. It extends in a massive stratum around the hills, and immense masses of it have broken loose and tumbled to the valley below.

The *Upper Freeport coal* was once mined by Mr Renfrew, but in the opening which has long since been abandoned, Mr Renfrew reports it as being two feet thick and quite good The *Freeport Limestone* is seen below it, and was once burned by Mr. Renfrew, who reports it as not slacking well

The *Lower Freeport coal* was also once mined here, down near the level of the Connoquenessing, but it, too, has not been operated for several years Mr. Renfrew says that a slaty streak occurred below its middle, and it was a little over two feet thick, but not so good a coal as the Upper Freeport, being more slaty and sulphurous.

On the north side of the Connoquenessing, near the township line, the *Buffalo Sandstone* is seen in an immense cliff, far up in the hill, and so many huge masses from it have collected in the valley below that they have obtained the name of "Town Rocks"—some of them are as large as an ordinary house.

9, Forward Township, Butler County.

This lies directly west from Penn, and north from Adams.

Connoquenessing creek enters it near its north-eastern corner, and with many windings and sharp curves reaches down to its center, when doubling on itself, it flows back north nearly to the line, and then turns to the south-west, and passes out of the township, near its north-western corner.

Glade creek puts into it from the north-east, near the center of the township, while Breakneck flows across its south-west corner.

The course of the Connoquenessing through this township is remarkable ; sweeping abruptly around in sharp curves, and continually changing, so that it sometimes flows towards all points of the compass within a very short space Near the center of the township it sweeps far to the south, and then doubling comes north, so that where the distance across the divide is barely one mile, along the bed of the creek it is nearly six. These great irregularities have very probably been caused by the character of the rocks through which it had to cut its way down; for, along its entire length in this township, the Buffalo Sandstone caps the sides of the hills in enormous sandstone cliffs, and when the stream was cutting its way down through this, it would, of course, select for its channel the path of least resistance, or those places in the sandstone mass which were most easily destroyed.

Descending the Connoquenessing from where we left it at the western line of Penn township, we find the Buffalo Sandstone still capping the bluffs along the stream at 150 to 180 feet above its bed. Two miles below Renfrew's mill, we get the following section, 197 feet high, on the land of Mr. Weaver: (Fig 58)

1.	Massive Sandstone, Buffalo, seen,	20'
2	Sandy Shales, and concealed,	30'
3	Streak of Coal, Brush creek (*Gallitzin*),	0'' to 4''
4	Concealed,	80'
5	*Coal*, Upper Freeport,	2'
6	Fire Clay,	4'
7	Limestone, Freeport,	4'
8	Concealed,	45'
9	*Coal*, Lower Freeport,	2'
10	Concealed to level of the Connoquenessing,	10'

Here the Buffalo Sandstone is seen encircling the hills in a line of massive cliffs

Gallitzin Coal.—Mr. Weaver has drifted several yards on No. 3, thinking it the same coal as that mined at Butler, and expecting it to thicken up to 4 feet very soon. It is a mere streak of coal in bituminous shales and occupies the horizon of the Brush creek coal

The same gentleman has also opened both the Freeport coals at this locality.

The upper one is represented to be 2 feet thick, and quite a good coal It could not be seen, however, as the bank had lately caved in The Freeport limestone is seen in the drain below the coal, and is very impure and ferruginous

The *Lower Freeport*, No. 9, could likewise not be seen, when I visited this locality, owing to water accumulating in the drift from choking of the drain. It is represented by Mr. Weaver to be 2 feet thick, but somewhat slaty and not so good a coal as the upper one

One mile below the last locality the following section is seen at Mr. Critchlow's 200 feet high: (Fig. 59.)

1. Massive Conglomerate Sandstone, Buffalo, seen,			50'
2. Concealed,			30'
3. Drab Sandy Shales,			30'
4. Massive Sandstone, seen,			5'
5 Concealed,			20'
6. *Coal*,	In the Mahoning Sandstone.	1 Impure Cannel, 6'' 2 Dark, Slaty Shales, 4' 3 Coal, 1' 2''	5' 8''
7. Shaly Sandstone,			25'
8. *Coal*, Upper Freeport,			1' 10''
9. Concealed to level of Connoquenessing,			35'

Here the *Buffalo Sandstone* reaches an immense development, as 50 feet of it was seen in a solid massive cliff which extends to the top of the hill. Immense masses of it are strewn along the creek bank, and it is quite conglomeratic

Coal in the (*Lower*) *Mahoning Sandstone.*—Nos. 4—7 represents the Mahoning Sandstone, which here contains some coal near the center of the mass. The upper layer is an impure cannel, while dark shales intervene between it and the coal below, which is fair looking, being bright and shining, and yields no copperas on exposure

The *Upper Freeport coal* has been mined here by Mr Critchlow, where it is said to be quite good, though only 22 inches thick. It has also been mined one half a mile below Critchlow's, by Mr Burr, on the opposite side of the creek.

To show the persistency of this series along the Connoquenessing, we give another section, 233 feet high, taken at a point 1½ miles below or ½ mile above Heid's bridge: (Fig. 60.)

1 Massive Sandstone, Buffalo,		70'
2 Dark Shales,		10'
3 *Coal*, Brush creek,	(*Gallitzin*,)	6''
4 Fire Clay and Shales,		10'
5 Concealed,		35'
6. Sandstone, massive,		5'
7. Sandy Shales,		2'
8. Fire Clay, with a streak of Coal at top,		3'
9. Concealed,		35'
10. *Impure Cannel*,	In Mahoning SS.,	6''
11. Dark Slaty Shales,		4' 6''
12. *Cannel, impure*,		6''
13. Black Slaty Shales,		5'

14. Flaggy Sandstone,	15′
15. *Coal*, Upper Freeport,	1′ 8″
16 Concealed to level of the Connoquenessing,	35′

Here the Buffalo Sandstone has an enormous development, and is, in many of its layers, a perfect mass of pebbles. Its huge massive fragments are scattered over the hillside from top to bottom

This section is interesting in showing how the Mahoning Sandstone is split up into several quite different strata, among which are two or three small coal beds The cannel coals, Nos 10 and 12 are very impure

The Upper Freeport has been mined at this locality on the land of Mr Slater. It is quite hard and brilliant, and tolerably good coal.

The Freeport Limestone was not seen below it, but is said to occur in the drain

One half a mile below this Mr Heid has opened a coal 110 feet above the creek, which shows the following section at the mouth of the drift: (Fig 61.)

1. Coal,	4″	2′ 6″
2 Shale,	6″	
3. Coal,	1′ 8″	

This is in the interval between the Buffalo and Mahoning Sandstones, and is probably concealed in the preceding section, being found in No. 5 It represents the Brush Creek coal. Mr. Heid says the coal is quite good.

At the mouth of Glade creek, the following succession is seen in descending the steep bluff opposite, 220 feet: (Fig. 62.)

1. Massive, coarse, Conglomerate Sandstone, Buffalo,		60′
2 Shales, seen,		8′
3 Concealed,		25′
4. Massive Sandstone,	Mahoning,	20′
5. Concealed,		55′
6. Flaggy Sandstone,		5′
7. Coal, Upper Freeport,		1′
8. Concealed,		40′
9. Bituminous Shale,		1′ 6″
10. Fire Clay,		2′
11. Concealed to level of Connoquenessing,		8′

No. 1 is the *Buffalo* conglomeratic sandstone which we have been following all the way down the Connoquenessing.

It is here very full of pebbles, many of them being as large as a hazel-nut It is a very coarse, yellowish white rock, and contains many casts and impressions of wood.

Nos. 4 to 6 represent the *Mahoning* Sandstone Nos. 1 and 4, both form massive cliffs, which extend in bold relief around the hill

No 7 is the *Upper Freeport coal.* It has been opened up here by some one, but is barely one foot thick, though very pure and bright looking. Passing up Glade creek from here, this coal is frequently seen in the road, and one mile up the stream from its mouth it is exposed at the roadside, where we see the following section: (Fig 63)

1. Dark Shales,	10′	
2 Coal,		10″
3 Shales and Fire Clay,	4′	
4 Limestone, Freeport,	3′	
5. Concealed to the creek,	3′	

Here the limestone has been quarried out of the creek bank, a short distance above Brown's mill, and the little coal has been stripped to burn it The limestone is somewhat ferruginous as usual, and slacks with difficulty on burning

As we ascend Glade creek from this point, the Upper Freeport coal and its underlying limestone, rise to the south-east, about as fast as the stream, so that the limestone is seen along the creek bed in many localities until we come to where Glade creek passes out of the township in ascending. It was once burned on the land of Mr. Hunter, two and a half miles above Brown's mills, but did not slack well. It is seen in the bed of the creek where the road crosses Glade creek just below the township line.

Breakneck creek flows through the south-western corner of this township It cuts down to the Upper Freeport coal, and, just below the Adams township line, the coal is mined on the land of Mr Mershing, where it shows the following section. (Fig. 64.)

1. Shales, Sandy, seen,			5′
2. Coal, Upper Freeport,	1. Cannel,	4″	2′ 4″
	2. Coal,	2′	
3. Concealed to level of the creek,			35′

The *cannel* coal at the top is quite good, and burns very freely, leaving considerable ash, however The bituminous coal is very impure, being filled with sulphur and slate, and well nigh worthless. A parting of slate runs through the bed near the bottom.

Three fourths of a mile below this, the Mahoning Sandstone is quarried at the roadside, on the land of Mr. May It is somewhat shaly at the surface, but on passing back into the hill it is very massive and compact. It is easily dressed, and of a grayish-white color It makes an excellent building stone.

Descending the stream further we see the blossom of a coal at the roadside a short distance above Evansburg, it is the Upper Freeport.

Just below this, the Mahoning Sandstone has been extensively quarried, on the land of Mr Ift, where we see the sandstone in a massive wall 25 feet high. It is an excellent building stone, splitting freely, dressing easily, and standing the weather very well.

Evansburg is at the township line, and in the village, the Upper Freeport coal has been opened by Mr. Boggs, and we get the following section at his drift: (Fig. 65)

1. *Coal*,	1′ 6″
2 F. C. and Shales,	3′
3. Limestone, Freeport,	4′
4. Concealed to Breakneck,	18′

The coal is not mined to any extent, as it is too thin for profitable mining.

The Freeport limestone is seen under it in huge blocks, which are weathered a deep buff from the iron it contains, though the rock is a light dove-color on fresh fracture

Returning to the mouth of Glade creek and following down the Connoquenessing, we find the immense Buffalo Sandstone still extending along that stream, at the tops of the hills, and covering their sides with its huge masses of conglomerate.

One half a mile above Buhl's bridge, a little stream puts into the Connoquenessing, and a short distance up this, a well was once bored for oil. Mr. Evans, who drilled the well, gave me the following record from memory, which, of course, must be properly discounted, as the memory of a column of figures becomes soon confused.

The well commences 45′ below the Upper Freeport coal: (Fig. 66.)

Evan's Oil Well record; from memory; 626′ +

1. Sandstone and Shales,	75′
2. Shales,	30′
3. Coal, Kittanning, . .	3′
4. Massive White Sandstone (Piedmont), .	160′
5. Shales, ...	3′
6. Coal, .	5′
7. Shales,	20′
8. Hard Blueish-white Sandstone, . .	80′
9. Soft Shales, alternating with hard, . . .	250′
10. Hard Blueish-white Sandstone to the bottom of the hole,	?

Gas and soft-water in this last, 35 feet above the bottom. The Upper Freeport coal has been opened 45 feet above the mouth of the boring, where it is one and a half feet thick. The Lower Freeport is seen one half foot thick in black slate, 10 feet below the well in going down the run. The greater part of No 1 is sandstone, it being the Freeport. The Darlington coal seems to have been passed through unnoticed, probably in the night.

No 3 is the Kittanning coal, and much the same condition of affairs seem to exist as at Homewood, in Beaver county; for No. 4 ought to be, in part, the Piedmont Sandstone, if not of quite incredible thickness.

One fourth of a mile below Buhl's bridge, the Buffalo Sandstone covers the hill top with its massive blocks, and there the following section of 225′ is seen: (Fig. 67.)

1. Concealed, but the surface is covered with massive blocks of Conglomerate Sandstone, Buffalo,	. 75′
2. Concealed, ...	. 40′
3. Sandstone, Mahoning, ...	. 20′
4. Concealed, ...	. 50′
5. *Smut of Coal*, Lower Freeport.	
6. Massive Sandstone, Freeport to level of the creek, ...	. 40′

The blossom of No. 5 is seen opposite the mill, in a bed of black shale. No 6, the Freeport Sandstone, is seen opposite Evans' mill, in a steep bluff, and is quite massive. It is twisted and contorted, and shows much false bedding.

One mile and a half below Buhl's bridge, the Darlington coal comes to the surface in the bed of the Connoquenessing, and has been extensively stripped out of the stream by Mr. Marshall. It is 3 feet thick, and a very fair coal. About 200 yards below this it rises above water level, and is mined by Mr. Marshall, at whose drift we have the following: (Fig. 68.)

1. Coal,	Darlington Coal, or Upper Kittanning,	1′ 8″	3′
2. Slate,		½″—1″	
3. Coal,		1′ 4″	

Here the coal is rich, oily, and brilliant, contains very little visible pyrites, and is highly valued as a domestic fuel.

The upper bench is rather better coal than the lower, but both are excellent, being used for smithing

One mile below this the Darlington is mined on the land of Messrs. Knouff, Anderson, and others. At one point, near Anderson's bridge, it becomes 4 feet thick Below this, one half mile, we get the following section of 134 feet on the land of Mr. Wall: (Fig. 69.)

1. *Limestone*, Freeport,	2′	
2. Concealed,	25′	
3 Massive Sandstone,	20′	
4. Dark Sandy Shales,	10′	
5. Coaly Shales,	3′	
6. *Coal*, impure,		8″
7. Sandy Shales,	1′	5″
8. *Coal*, Lower Freeport,	2′	
9. Fire clay and Sandy Shales,	5′	
10 Limestone, Butler,	3′	
11. Fire Clay, containing nodules of Iron Ore,	4′	
12. Sandstone and Sandy Shales, Freeport,	43′	
13. *Coal*, Darlington, (Upper Kittanning)	3′	
14. Concealed to the creek,	12′	

No. 1 is seen exposed in a field belonging to Mr. Wall. It is quite compact, and somewhat brecciated. No appearance of coal is seen above it.

No. 3 may represent the *Butler Sandstone.* No. 6 has been dug out of the hill by Mr. Wall, and used in burning the limestone below He reports the coal as being good.

No. 10 is the *Butler Limestone*, and is seen well exposed in a ravine, where the section was taken. It is a very ferruginous limestone, compact, of a dark gray on fresh fracture, and somewhat brecciated Mr. Wall once burned it, and he says it made excellent lime for agricultural purposes, though it was rather difficult to slack.

The fire-clay below it contains many large nodules of calcareous iron ore; in fact, is only a more ferruginous portion of the limestone.

Mr. Wall mines the Darlington coal, and reports it as 3 feet thick, with a parting of slate below the middle.

10. Jackson Township, Butler County.

This lies west from Forward, north from Cranberry, and adjoins Beaver county The Connoquenessing flows across the township from east to west, and receives, near the center of its course, two important tributaries, viz· Little Connoquenessing and Breakneck.

Scholars' run, a considerable stream, also puts into the Connoquenessing from the north, opposite Zelienople

The topography in Jackson, along the Connoquenessing, is very different from that in Forward; for here lower strata have come to the surface and thrown the Buffalo Sandstone far back in the hill tops, and the sandstone itself has thinned away on leaving the border of Forward, and is not seen as a massive conglomerate in Jackson

In the vicinity of Harmony & Zelienople are some of the finest farms in the country

Commencing on the Connoquenessing, where we left off at Mr. Walls', near the Forward township line, and coming down it, we see the Darlington coal running along a few feet above the bed of the stream, and falling about as fast as the latter.

One half mile above Peffer's bridge we get a section of 131 feet descending to the right bank of the stream: (Fig. 70.)

1. Sandstone, somewhat massive,			10′
2. Dark Sandy Shales,			10′
3. Coal, impure,			4″
4. Sandy Shales and Sandstone,			35′
5. Coal, Lower Freeport,	1. Coal,	1′ 4″	4′ 9″
	2 Clay,	1′ 8″	
	3. Coal,	1′ 9″	
6. F. C,			3′
7. Sandstone, Freeport,			40′

8. Coal, Darlington,	1. Coal,	1' 7''	3'
	2. Slate,	1''	
	3. Coal,	1' 4''	
9 Fire clay,			3'
10. Sandstone,			12'
11. Concealed to the creek,			10'

The *Lower Freeport coal* is here double, being separated into two benches by a parting of fire-clay, both of which are rather slaty. The coal has been stripped out of a ravine near the saw-mill.

The Freeport Sandstone in this section is quite shaly.

The Darlington coal is exposed along the creek bluff, and it has been opened in several places. It is mined near the saw-mill by Mr. Sitler, at an elevation of 25 feet above the stream.

A short distance below Peffer's bridge, the Darlington coal is mined by Mr. George Beam, of Harmony, where it is six feet above the creek, and shows the usual section, with the parting of slate near the middle.

Just below the mouth of Breakneck, the Darlington coal takes a curious freak and shows the following section: (Fig. 71.)

1 Coal,	2' 9''		6' 11''
2 Sandy Shales,	1'		
3 Coal,	1' 5''	3' 2''	
4 Parting,	½''		
5. Coal,	1' 8''		
6. Concealed to the creek,			5'

Here we get the *Darlington duplicated*, but it is quite local; for one half a mile above, the upper bed is absent, and 10 rods below it is not present. This upper bed is seen not to be formed by a thicking of the slaty parting of the main bed, but is *an altogether new deposit*, since the lower part exhibits the structure of the Darlington complete, as it is seen a few rods below, near the mill.

Just opposite Ziegler's mill, we see this section: (Fig. 72.)

1. Coal, Lower Freeport, reported,			2½'
2 Concealed,			50'
3. Sandstone and Shales,			13'
4. Conglomerate mass of Coal, Iron Ore, Sandstone, Plants, &c.,			2'
5. Coal, Darlington,	1. Coal,	1' 6''	3'
	2. Slate,	½''	
	3. Coal,	1' 5½''	
6. Fire clay to the creek,			4'

THE HUNT LIBRARY

This is only 10 rods below where the double coal bed occurs, and the *upper part has completely vanished* here. It probably owes its origin to drifted vegetation.

No. 1 was once mined and used at the mill, but the opening is fallen in, and nothing can be seen of it now. It is reported to have been 2½ feet thick, however, and an excellent coal. The same coal is now mined just opposite, on the other side of a little stream, where it is worked by Mr. Schantz, and is generally known as the "Schantz" coal. It is there 2½ feet thick, besides a slaty coal roof, which is not taken down. It is a very clean, bright, hard coal, having its laminae separated by thin layers of mineral charcoal. It contains very little sulphur, and is in high repute generally.

Conglomerate mass of coal, ore, sandstone, shale, &c.—No. 4 is a conglomerate mass of lumps of coal, nodules of iron ore, broken and rounded masses of sandstone, and shale, together with many vegetable fragments The fragments of rock and coal are as large as one's fist, and it was evidently a strong current which caused this commingling.

Ascending Breakneck creek from this point, we find the Lower Freeport coal mined one half mile above its mouth, by Mr Boyer, and at this drift we see this section: (Fig. 73.)

1. Sandy Shales,			10′
2. Coal, Lower Freeport,	1. Cannel, impure, seen,	1′	4′
	2. Shale,	1′	
	3. Coal,	2′	
3. Concealed to level of creek,			30′

The top bench is a kind of semi-cannel coal, and sometimes, quite slaty. It is not always taken out.

The lower bench is an excellent coal, is very free from impurities of any kind so far as the eye can judge, and is in high repute, both as a smithing coal and for domestic purposes. It is the same coal that is worked by Schantz

The coal dips very rapidly to the south, since at Mr. Luntz's bank, 60 rods south from Boyer's, the coal is only 8 feet above the creek.

Descending the hill on Mr Luntz's land, we get the following section of 150 feet: (Fig. 74.)

1. *Smut of Coal*, Brush creek (Gallitzin coal).			
2. Sandy Shales,		40′	Mahoning Sandstone, 60′
3. Massive Sandstone,		20′	
4. Coal, Upper Freeport,			1′ 6″
5. Fire Clay,			1′ 6″
6. Limestone, Freeport,			2′
7. Sandy Shales and Sandstone,			45′
8. Concealed,			15′
9. Sandy Shales,			15′
10. Lower Freeport Coal,	1 Cannel,	1′ 1″	4′ 1″
	2 Shale,	11″	
	3. Coal,	2′ 1″	
11. Concealed to Breakneck,			5′

No. 1 is the *Brush Creek coal.* Its blossom only is seen here, but on the other side of the creek it has been opened by Mr. Burr, and is there 16 inches thick, and a tolerably fair-looking coal The Upper Freeport has been opened at this point by Mr. Luntz, but it was only 18 inches thick, and was, of course, too thin to mine

Mr. Luntz has burned the Freeport limestone, and says it slacks well, and is very good for agricultural purposes.

The Lower Freeport coal has been mined at this point, by Mr. Luntz; it is quite as good as at Mr. Boyer's.

One mile above Mr Luntz's, the Brush Creek coal and also the Upper Freeport, have been opened by Mr. Beam. At the mouth of the drift the Brush Creek was 2½ feet thick, but on following it into the hill, it ran down to 20 inches or even less.

One half mile below Evansburg, the *Upper Freeport Coal* has been opened by Mr. Likens on each side of a run, where it is 18 inches thick, and 40 feet above the bed of Breakneck. Just below Evansburg it has also been mined, in several places, on the land of Mr. Stewart. It is quite thin and impure.

Returning to the Connoquenessing, at Ziegler's mill, and passing down the stream, we find the *Darlington coal* still falling to the west, about as fast as the stream, and just below the mouth of the Little Connoquenessing, this coal is mined extensively by Mr. Fielder, at whose drift the coal shows the following section: (Fig. 75.)

1. Coal,	1' 4"	2' 7"
2. Slate,	1"	
3. Coal,	1' 2"	
4. Concealed to the creek,		10'

The coal is not quite so thick as it has been above. It is a very brilliant coal, but contains a considerable amount of pyritous slate in thin laminæ.

These are the most extensive mines in the neighborhood, and from them Harmony and Zelienople are largely supplied.

Passing down to Harmony, we see the *Freeport Sandstone* thickening up, and just above the bridge across the Connoquenessing, it is seen in a massive cliff 70 feet high

Just opposite Harmony, the Darlington coal is mined by Mr. Sample, and there we see the following: (Fig 76)

1. Massive Sandstone, Freeport,			25'
2. Coal, Darlington (U. K.),	1. Coal,	1' 9"	2' 5"
	2. Slate,	½"	
	3. Coal,	7"	
3. Concealed to level of the creek,			12'

The Freeport Sandstone is very massive, and is seen in a vertical cliff along the stream. It rests immediately upon the coal, and contains many fragments of wood, principally broken and drifted trunks of *Sigillaria.*

At Harmony, a well was once bored for salt water, and a coal four feet thick was passed through 45 feet below the Darlington. This is the Kittanning.

One half mile south-east from Harmony, we get 390 feet of rocks descending Ziegler's Hill: (Fig. 77.)

1. Concealed, with occasional exposures of Shales,	160'
2. Mahoning Sandstone,	60'
3. Shales,	10'
4. Coal, Upper Freeport,	1' 8"
5. Fire Clay,	1' 6"
6. Limestone, (U) Freeport,	2'
7. Concealed to level of Connoquenessing creek,	155'

The Upper Freeport coal has been opened by Mr. Ziegler, and the limestone, below it, taken out for burning. The coal, though so thin, is quite good, and was used in burning the lime. The limestone is very ferruginous and brecciated, and did not slack well.

At Zelienople, the Darlington coal is mined by Mr. Passavant, just below the Lutheran church, five feet above the level of the creek, and the bank flooded during high water. The coal is mined under the town

At Seidel's mill, below Zelienople, we get the following 94′ descending the steep hill, on the right bank of the Connoquenessing :— (Fig. 78.)

1	Smut of Coal, Lower Freeport,	?
2	Concealed,	7 ′
3.	Massive Sandstone, (L) Freeport,	63 ′
4.	Coal, Darlington,	2 ′ 4″
5.	Fire Clay and Sandy Shales,	19 ′
6	Stratum of Calcareous Iron Ore,	6″
7.	Dark Shales, containing much Iron Ore to the level of the Connoquenessing,	12 ′

No 1 represents the Lower Freeport coal, and a short distance away, in a ravine, the *Butler limestone* is seen under it. This was here mistaken for the Freeport limestone, by the First Geological Survey.

The Freeport Sandstone is quite massive, and forms a perpendicular bluff 70 feet high along the stream.

The Darlington coal has been mined in several drifts. It contains much sulphur and its exposed surface is covered with copperas.

The shales below No. 8 contain large quantities of iron ore in nodules and also in continuous layers from 6 to 8 inches thick. The Darlington coal was here mistaken for the Lower Freeport, during the First Survey.

The shales at the bottom of the section are getting quite bituminous, and we should find the Kittanning coal about 15 feet below the creek.

At the bridge, below Zelienople, the Darlington coal is mined by Mr. Allen, at an elevation of 20 feet above the stream. Where the Rochester road crosses Shaw's run, below Zelienople, the Darlington coal is seen at the roadside ; and, ascending the hill, the smut of the Upper Freeport coal occurs 150 feet above it.

Passing up the Little Connoquenessing, the Darlington coal runs under that stream before we come to the bridge, on the Butler and Harmony road, but comes to the surface again near the mouth of Yellow creek.

11. Lancaster Township, Butler County.

This lies immediately north from Jackson, and adjoins both Beaver and Lawrence counties.

Scholars' run heads up near its northern border, and flows south through it to the Connoquenessing at Zelienople.

Yellow creek also cuts down through it from the north, and enters the Little Connoquenessing, which passes through its south-east border, entering from Connoquenessing township.

Along Scholars' run there is nothing of interest; for the Darlington coal goes under a short distance above its mouth, and does not re-appear again to the north, while neither the Upper nor Lower Freeport coal becomes of workable thickness along this stream.

Yellow creek, however, cuts down to the Darlington coal, which is exposed throughout its entire length, lying only a few feet above the creek, and rising just as fast as it does. Three fourths of a mile above the mouth of this stream, the coal is mined by Mr. Measel, and there we see the following structure of the bed: (Fig. 79.)

1. Coal,	1' 2''	2' 9''
3. Slate,	1''	
4. Coal,	1' 6''	

The coal is tolerably good, though there is rather too much sulphur in it for many purposes.

Half a mile above the mouth of Yellow creek, a well was bored for salt water in 1824, by Mr. Webster Wilson, of New Brighton, who kept a minute record of the different strata passed through, and kindly placed it at my disposal. The well commences just above the horizon of the Darlington coal, and shows the following: (Fig. 80)

The Webster Wilson Salt Well Record; 1824.

1. Conductor hole,			5'
2. Shales and Slates,			42' 8''
3. Black Slate,			6' 6''
4. Slaty Coal,	1' 4''	Kittanning,	4' 9''
5. Coal, good,	3' 5''		
6. Fire Clay,			2' 4''

7.	Hard Sandstone,		9′	6″
8	Black Slate, mixed with streaks of Coal,		8′	1″
9	Hard Blueish-white Sandstone,		87′	7″
10	Coal (at 150′ from top),	(Clarion)	3′	1″
11.	Shales,		10′	3″
12.	Hard Sandstone, SaltWater at bottom,	(Piedmont Sandstone)	19′	7″
13	Black Slate,		2′	11″
14	White Hard Sandstone,		8′	11″
15.	Coal and Slate (at 192′),		2′	3″
16.	Hard White Sandstone,		18′	11″
17.	Dark Slate and Coal,		3′	
18.	Very Hard, White Flinty Sandstone,	(XII)	40′	6″
19	Coal,		2′	7″
20	Shales,		15′	
21.	Coal (at 255′),		5′	
22	Fire Clay,		8′	
23.	Shales, hard and soft, to bottom of the well (at 328′),		40′	
	Total depth of well record,		339′	

This record is not difficult to read No. 5 is the Kittanning coal No. 10 is the Clarion, being the same distance below the Darlington coal here, which we find it at New Brighton. Nos. 12 to 16 represent the Piedmont Sandstone No. 18 represents the Upper Connoquenessing Sandstone, while 19 to 21 represent the series of coals, which we find under that rock, along the Connoquenessing, between its mouth and Slippery Rock.

The *Ferriferous limestone* may not have been recognized as limestone, or the stratum may be entirely wanting here, being cut out by the Sandstone, No. 9, which occupies its proper horizon

Salt was manufactured here for a long time. The water came from No. 18.

The well was drilled by water power, and was about one year in going down, seldom getting more than one or two feet per day, and often only a few inches. The difference between the assigned depth of well and sum of the thicknesses, is to be explained as usual, by expansion and contraction of rope, &c., &c

The record was kept much more minutely than I have given it There is every reason for believing it perfectly correct, for it agrees admirably with the conditions existing along the Connoquenessing, ten miles below where these strata are exposed, and then Mr. Wilson was a close and accurate observer, and took a pride in such matters.

The Darlington coal is mined by Mr. Bieber at the road side, one and a half miles above the mouth of Yellow creek, and there we see the following section: (Fig. 81.)

1 Massive Sandstone, Freeport, seen,			10′
2 Dark Shales, containing Iron Ore,			3′
3. Coal, Darlington,	1 Coal,	1′ 1″	3′ 2″
	2. Slate,	1″	
	3. Coal,	2′ 0″	
4. Fire Clay, seen,			3′
5. Concealed to the creek,			10′

There are many "sulphur binders" in the upper part of the bed, but the lower bench is quite pure, and can be used for smithing. The coal is shining black, and comes out in nice blocks, being very rich and oiley. The streak of sulphurous slate which runs through the coal, separating it into two benches, is quite hard, and sometimes gets to be two inches thick.

A short distance below the mouth of Little Yellow creek, the coal was once mined by Mr Koch, near the old mill, but the mines are now abandoned.

On Little Yellow creek, the coal runs under the stream, one mile above its mouth, and has there been stripped out of the bed of the creek by Mr. Kinker.

From the mouth of Little Yellow creek, up the main stream, the Darlington coal is constantly accessible, keeping a few feet above the stream, until we pass out of this township into Muddy Creek township Every farmer could open it, but not a single bank is in operation now along this line, though quite a number have been opened at some time and allowed to fall in The farmers say it is cheaper to buy their coal and haul it four or five miles than to keep a bank open for their own use, and I doubt not that this is true, when, as is the case with most of them, a new bank has to be opened every year owing to the want of a little intelligent care in properly making and fixing up the entry.

Just north from this, in Muddy Creek township, the coal is quite extensively mined before it passes under Yellow creek.

Ascending the Little Connoquenessing creek, its water-bed rising rapidly eastward, the Darlington Coal, which is at water level at the mouth of Yellow creek, goes under and is seen no more.

Eichenhaur's Local Coal.—One mile east from Yellow creek we come to a singular coal on the land of Mr Eichenhaur. (Fig. 82.)

1. Massive Sandstone, . .			10′
2. Sandy Shales, . . .			8′
3. Coal, .	1. Cannel,impure,	1′	8′ 1″
	2 *Coal,*	3′ 4″	
	3 Sandy Shales,	1′ 3″	
	4. *Coal,*	2′ 6″	
4. Concealed to level of the creek, .			70′

This is a very strange coal, and at first was thought to be the Darlington, which had been thrown up by some unknown anticlinal; but the Darlington is 85 feet lower one mile west, and a most vigorous search failed to show any axis passing across the measures which could give such a hoist as this, either on the Little creek or the Big one just south. It is, therefore, an entirely new feature introduced in the series between the Lower Freeport coal and the Darlington, and is one of those local deposits with which we sometimes meet. It was discovered here only a few years ago, and has never been found on any of the farms immediately adjoining this below, though much labor and capital has been expended in prospecting for it. In fact, only 200 yards below, it has turned into a bed of bituminous shale, several feet thick with thin layers of coal intervening.

The top of the coal is a kind of slaty *cannel*, and the whole upper part of the bed has a *semi-cannel* structure It at times becomes quite slaty, however, and is inferior, as a fuel, to the lower bench.

The sandy shale, separating the two benches, thins away to only 3 or 4 inches, on going back into the hill, as I am told by Mr. Eichenhaur, and then there is about 7 feet of workable coal in a body. Sometimes this sandy shale supports a foot or so of fire clay, and again the fire clay is absent altogether.

The lower bench of the coal is very fair, being quite free from impurities, and represented by Mr. Eichenhaur, who uses it in his blacksmith shop, to be a superior coal for smithing purposes.

At the mouth of Crab run, three fourths of a mile above this, we get the following section in descending a steep hill to the Little Connoquenessing (181′) :— (Fig 83)

1. Coal, "Brush Creek," . (Gallitzin)			3′ to 4′
2 Fire Clay,			4′
3 Concealed,			46′
4 Coal, Upper Freeport,			1′ 6″
5. Concealed,			115′
6. Coal, (Eichenhaur's)	1 Coal, Slaty,	1′	8′ 8″
	2. Coal,	2′ 8″	
	3. Fire Clay,	1′	
	4. Sandy Shale,	1′	
	5. Coal,	3′	
7 Concealed to level of Little Connoquenessing,			2′

Here No. 1 is a coal that has come into the section, 50 feet above the Upper Freeport It was once opened by Mr Kiefer, and is said to run from 3 to 4 feet in thickness, and to be an excellent coal. No. 4 is the Upper Freeport, and was opened by Mr Kiefer. It is reported to have been 1½ feet thick, with the Limestone below it.

No. 6 is the same coal as that mined below at Eichenhaur's, and, as will be seen, exhibits much the same structure. The lower bench of the coal occurs down at the level of Crab run, and its top only was seen, but Mr. Kiefer told me the lower bench was 3 feet thick The coal dips down to the north-east, and, as it occurs so near the level of the creek, it cannot be drained, and is now abandoned. The whole bed was taken out as far in as the drain would carry off the water, and then the lower bed was left, and the upper one was carried in until it, too, sank below drainage.

The upper bench is somewhat slaty and impure, like the same coal at Eichenhaur's, and is inferior to the lower part.

The Lower Freeport Coal about 50 feet above this was seen along the road above.

The Brush Creek Coal is mined a short distance above Mr. Kiefer's, by Mr Wurster, at an elevation of 180 feet above the creek, and just opposite to it, the Eichenhaur coal passes under, and is seen no more.

We term this upper coal the Brush Creek, though there is much room for doubt about the identification, but the one 50 feet below it is certainly the Upper Freeport, as it is underlaid by the Freeport Limestone.

12 *Connoquenessing Township, Butler County.*

This lies immediately east from Lancaster, and north from Forward; and, as in the latter township, we found the Connoquenessing pursuing a very tortuous and winding course, hemmed in between two walls of massive sandstone, so here we find the Little Connoquenessing winding about in much the same way, with the immense Buffalo Sandstone capping the steep bluffs

Just across the Connoquenessing township line from Lancaster we come to the coal-works of Mr. Daniel Cable, and get the following section of 285 feet: (Fig 84)

1. Massive Sandstone, Buffalo, ...	40 '
2. Concealed, . . .	70 '
3. Coal, Brush Creek (Gallitzin), . .	3' to 4 '
4. Fire Clay, ...	3½'
5. Sandy Shales and Sandstone, .	13 '
6. Concealed, . .	115 '
7. Coal, Lower Freeport, Blossom.	
8. Fire Clay, and Shales,	5 '
9. Limestone, Butler, . . .	?
10. Concealed to level of the Little Connoquenessing,	35 '

Mr. Cable mines the coal, No. 3, quite extensively, and it is the source of supply for a wide extent of territory, much of it being hauled to Harmony and Zelienople, as it is preferred to the Darlington of that locality. It is the same bed as that worked below by Wursted & Kiefer at this horizon in Lancaster township. At Mr. Cable's it is a very fair coal, being brilliant, rich, and oily, and containing only a small quantity of pyrites. It has a good reputation as a smithing coal, and for domestic purposes

No. 1 is not fully exposed, being partly concealed in a steep bench at that horizon, but huge blocks of it cover the hill-slopes.

No. 7 is the Lower Freeport. An opening was once made in it at this locality, and the coal is reported to be 2 feet thick. The *Butler Limestone* is seen below it in ferruginous *nodules*, which have rolled out of their beds.

The blossom of the Lower Freeport coal is seen along the road from here up to the little run which comes into the creek at the school-house, and there an attempt was made to open it, but the coal, while apparently making a large blossom, was found to be rotten, and a kind of carbonaceous muck. No doubt, however, if the drift had been but carried in far enough, the coal would have become solid, as there is very little earth over it here, and the coal was decomposed where the drift was made.

At the roadside, on the little run coming in at the school-house, the *Brush Creek coal* has been mined by Mr. McCandless, and descending from the hill above we see the following section of 235 feet. (Fig. 85.)

1 Massive Sandstone, seen, Buffalo,	80 '
2 Concealed,	65 '
3 Coal, Brush Creek (Gallitzin),	0'to 3½'
4. Concealed,	55 '
5 Coal, Upper Freeport,	2 ' 4''
6. Shales,	10 '
7. Limestone, Freeport,	4 '
8. Concealed to Lower Freeport Coal at the school-house,	65 '

Here the *Buffalo Sandstone*, No 1, is seen in a huge cliff running around the hill It is not so conglomeratic as usual, and on the opposite side of the Little Connoquenessing is extensively quarried by Mr. Moder, where it is a splendid building stone.

The Brush creek coal has been mined by Mr. McCandless, who finds it very irregular in its deposition. Where the drift was opened it was 3½ feet thick, and continued that for some distance back in the hill, but it suddenly fell off to almost nothing, and the mine was abandoned

No. 5 is the Upper Freeport, it is mined in the hollow below by Mr. McCandless, and shows the following section: (Fig. 86)

1 Shales,			10'
2 Coal,	Upper Freeport,	1' 8''	2' 7''
3 Slate,		1'' to 2''	
4. Coal,		10''	

The *Upper* Freeport Limestone is not seen here, as the interval is concealed; ascending the little run, we come to it, a short distance above. The coal is quite dirty and impure, containing much sulphur and slate

The *Upper* Freeport Limestone is quarried and burned on the land of Mr. McCandless, it is very compact, of a light dove color on fresh fracture, but contains much iron in the shape of nodules imbedded in it, which, not weathering away so rapidly as the limestone, give it a very rough appearance. The lime from it is of a reddish white cast, and requires careful burning to get it to slack well.

The *dip to the south* is very rapid at this locality. Just above this the course of the Little Connoquenessing makes a big sweep to the north, as we ascend, and the *Brush Creek coal* is mined no more until we come to near the mouth of Semiconon, 3 to 4 miles above There it is mined on the land of Mr Graham, 125 feet above the stream. The coal is very good, and varies in thickness from 3 to 4 feet.

A short distance above the mouth of Semiconon, we find the Brush Creek coal mined by Mr Wilson, and there we see the following: (Fig. 87.)

1. Sandy Shales,			5′
2. Coal, Brush Creek,	1 Slaty Coal,	8″	4′ 4″
	2. Coal,	3′ 8″	
3. Concealed to level of Semiconon creek,			100′

The coal is not as good here as at Mr. Cables, since it contains so much pyrites that it cannot be used for smithing.

This coal is mined just above Mr. Wilson's by Mr. Edmonson. One and a half miles above the mouth of the Semiconon this coal has been extensively mined in the vicinity of Allen's mill. A short distance below it we get the following 157 feet: (Fig. 88.)

1. Massive Sandstone, Buffalo, seen,	20′
2. Black, Coaly, Bituminous Shales,	10′
3. Concealed,	40′
4 Drab, Sandy Shales,	15′
5 Dark Shales,	15′
6 Coal, Brush Creek (Gallitzin),	2′
7. Fire Clay,	2′
8. Concealed,	45′
9. Fire Clay, with streaks of Coal (Upper Freeport) at top,	5′
10. Limestone, (U.) Freeport, in bed of creek at the mill,	8′

No. 1 is seen in a bold cliff, extending around the hill, and its huge fragments, as large as a house, are scattered over the hill side

No 2 was once drifted upon, as it resembles a cannel coal, but it is too dirty and impure to burn.

The Brush Creek coal is here mined by Mr. Martin, and is quite thin, but just a few rods below Mr. Allen finds the same coal 3½ to 4 feet thick, and on the opposite side of the creek it attains 5 feet in some places.

The Upper Freeport coal is represented by a mere streak at the top of No. 9

Mr. Allen, taking the advice of Prof Rogers to look for the Upper Freeport coal a few feet above the limestone, drove an entry on No. 9 for several rods, expecting to find the few inches of coal thicken up into a valuable bed, but was disappointed.

The (U.) Freeport Limestone is seen just below the dam, or mill race, in the water-way. It is much brecciated, and contains considerable iron; it is quite hard and compact, however, and has been burned into lime. Mr. Allen has an opening in the *Brush Creek coal* a short distance above the mill, and on the opposite side of the creek this coal has been extensively mined on the land of Mr. Galloway. Here the coal varies much in thickness , at some points being 4 feet 10 inches, and again running out entirely.

A short distance east of Whitestown, the blossom of a coal is seen 110 feet above the Brush Creek Coal; probably the bed which occurs over the Buffalo Sandstone at some localities.

On a small branch of Crab run the Brush Creek coal is mined for local use by Mr. Millison. It is there only 2½ to 3 feet thick, however, and is not very valuable.

On the high ground in the vicinity of Whitestown there are broad level tracts of land, where the underlying rock is the massive Buffalo Sandstone, which has resisted the cutting action of the streams, and the softer shales above have yielded readily to the leveling action of the elements.

Near the southern margin of this township Little Connoquennessing and Big Connoquenessing are separated from each other by only ¼ mile. Between them a very high ridge rises to 450 feet above the Darlington coal, and ought to take in the Crinoidal Limestone on some of the higher knobs.

13. Butler Township, Butler County.

This lies directly east from Connoquenessing, and north from Penn. It is drained by the Conoquenessing and its tributaries Newman's branch and Karns branch unite at the eastern border of the township to form the main stream, which flows through it from north-east to south-west.

Commencing on the Connoquenessing, where we left it in Penn township, near the mouth of Thorn creek, and passing up the same into Butler, we find the country along its banks a perfect wilderness for several miles. The stream flows between two hill sides, with steep bluffs, capped at the top by immense cliffs of the Buffalo Sandstone, whose huge fragments cover their slopes, and block the stream below.

Opposite the bridge, which spans the Connoquenessing, one and a half miles above Renfrew's mills, the Buffalo Sandstone is seen in a massive cliff, extending around the hill, 175 feet above the stream. It is a regular conglomerate, many of its layers being a mere mass of quartz pebbles. Everything is covered up along the slopes by the rocky debris, and no section can be obtained. The massive Buffalo Sandstone continues in sight for a long distance up the streams, capping the hills, and two miles above the bridge last mentioned, we get the following section in descending a steep hill for 170 feet: (Fig. 89.)

1. Concealed, but covered at top with massive blocks of the Buffalo Sandstone,	100′
2. *Coal*, Upper Freeport,	?
3. Concealed,	45′
4. *Coal*,	Blossom.
5. Concealed to level of the stream,	25′

No. 2 has here been mined at one time, but the openings have now all fallen in and been abandoned, so that nothing could be learned of its quality or thickness.

About one and a half miles below Butler, Butcher's run puts in from the south-east, and on this stream and its tributaries, the *Upper Freeport coal* is very well developed, and mined extensively to supply the town of Butler, one mile distant to the north.

Ascending this run, the first coal-works we come to are those of Mr. Joseph Bredin, at whose bank we get the following 195 feet of section (Fig 90.)

1. Massive Sandstone, Buffalo, seen,			30′
2. Concealed,			100′
3. *Coal*, Upper Freeport,	1. Slaty Coal,	6″	4′
	2 Coal, good,	2′ 6″	
4 Concealed, with a Coal Blossom at 40′,			60′
5. *Coal*, Lower Freeport,			1′

Here the Buffalo Sandstone is marked by a massive cliff, around the hills, above the Upper Freeport coal This is the same rock which occurs all along the Connoquenessing, from the mouth of Breakneck to Butler.

The coal at this bank is quite good, being brilliant, and rich in bituminous matter. It seems to contain very little pyritous slate, and has been used for smithing In interval, No. 4, a small coal blossom is seen 40 feet below the Upper Freeport. It is merely local, however, as No 5, the Lower Freeport, has been opened up, but was found to be only one foot thick.

Just above where the Butler and Pittsburg turnpike crosses Butcher's run, the Upper Freeport coal is mined by Mr. Hoffner. Along the plank road toward Butler it is extensively mined at the shafts of Mr Shaffner, and descending the plank road from the top of the hill there, we see the following 295 feet of section: (Fig. 91)

1 Sandy Shales,	60′
2. *Coal*,	1′
3. Sandy Shales,	20′
4. Massive Sandstone, Buffalo, partly seen,	40′
5. Concealed,	90′
6. *Coal*, Upper Freeport,	3′ to 4′
7. Concealed to level of Butcher's run,	80′

Here No. 3 is seen along the plank road, just south from the top of the hill. This is the same coal which we saw near Mr. Renfrew's, in Penn township, at this horizon. The *Upper Freeport coal* is mined by Mr. Shaffner quite extensively to supply the town of Butler. The coal varies much in thickness, being in some places 4½ feet thick, and again running down to almost nothing. It is very sulphurous at times, and cannot be used for smithing, though it is a tolerably good coal for domestic purposes, making a strong, hot fire, and lasts well in the grate.

Passing north along the Butler road to Butler, we find the coal mined above the road at the works of Mr. Muntz, where by descending the hill past the cemetery, we get a more complete section of 288 feet: (Fig 92)

1. Massive Sandstone, Buffalo,			30′
2 Concealed,			10′
3. Fire Clay, with streak of Coal at top (Brush Creek),			5′
4. Concealed,			5′
5 Sandstone, somewhat massive,	15′	Mahoning,	65′
6 Sandy Shales,	50′		
7. *Coal*, Upper Freeport,			3′ to 4′
8. Concealed,			35′
9. Massive Sandstone, Butler,			33′
☞ Continued from here by boring.			
10. Surface debris,			8′ 4″
11. Sandstone,			2′ 6″
12. Shaly Sandstone,			14′
13 Shales, with Black Slate,.			5′
14. Sandy and Argillaceous Shales,			10′ 6″
15. Black Slate,			2′ 4″
16. *Coal*,			1′ 2″
17. Sandy Shales,			7′
18. Sandstone, . .			2′
19. Black Slate,			2′
20. Sandy Shales,			11′
21. Black Slate,			2′
22. Blueish Shales,			18′
23. Black Slate, .			2′
24. *Coal*, .			6′
25. Fire Clay to bottom of hole,	(Total, 95′ 10″) .		8′

There is a streak of coal and bituminous slate at the top of No. 5, and it probably represents the Brush Creek coal.

Nos. 5 and 6 represent the Mahoning Sandstone, which is here not at all massive, and shows only a few feet of solid sandstone at top. In a shaft near here, on the land of Mr. McQuiston, there was about 40 feet of massive Sandstone at this horizon.

The *Upper Freeport coal* is mined extensively by Mr. Muntz, and is a very fair coal for grate and steam purposes, but contains too much sulphur for smithing. This coal occurs in the town of Butler, just opposite Mr. Muntz's and was found in excavating for the foundation of the Court-House

The (U.) Freeport Limestone is there seen below it, and has frequently been dug from cellars of the houses.

Type locality of the Butler Sandstone :—

Below the Upper Freeport coal we get a very massive sandstone, which, from this locality, I have termed the Butler Sandstone. It is seen in immense masses just below Mr. Muntz's, opposite the mills of Woldo & Bros., and has been extensively quarried at that locality.

A short distance north from here it attains an immense development, extending up to within 10 feet of the Upper Freeport coal. This is the rock which has been quarried so extensively near the cemetery. It is a coarse, hard micaceous rock, of a yellowish-white color, and often tinged with red. It is there 50 feet thick. The *Lower Freeport coal* is seen below it 2½ feet thick, but too slaty to be of any economical importance. Several drifts have been driven upon it, a short distance east from the railroad station, but, in all, it was worthless.

The *Butler Limestone* is seen 5 feet below the coal in a cutting along the railroad near the bridge, where it is 3 feet thick and quite compact, though somewhat brecciated.

From No. 10 down the section is continued by a boring made for water by Mr. John N. Muntz. The conductor hole passes below the horizon of the base of the Butler Sandstone. The top of the hole is thirty feet above the creek.

The *Lower Freeport coal* seems to have been passed through unobserved.

The *Coal bed* marked No. 15 is probably a local coal, or it may be the Darlington, but the probabilities are that the *Darlington* is No. 23, as that comes at an interval of 156 feet below the Upper Freeport, which is a much smaller interval than we ever find in this region between that coal and the Kittanning. The thickness has probably been made two or three feet too large ; it is always very difficult to tell exactly the thickness of a coal passed through in boring. It is reported by Mr. Muntz to have been a very fair looking coal, as brought up by the sand pump.

The *Upper Freeport coal* is mined by Dr. Bredin, one half mile south from Butler, and there we see the following section of 116 feet: (Fig. 93.)

1. Coal, Upper Freeport,	3′ to 4′
2. Fire Clay and Shales,	5′
3. Limestone, Upper Freeport,	3′ to 12′
4. Concealed to Connoquenessing creek,	95′

The Freeport Limestone occurs in a tunnel which commenced 25 feet below the coal, and was driven up to drain the bank. The miner who dug the tunnel told me that the limestone varied much in thickness, sometimes being very compact, and not more than 3 feet thick, in a single layer, while again it would be scattered in huge nuggets through 10 to 12 feet of shales and fire clay.

The coal at Dr. Bredin's is quite variable in thickness, and runs out altogether in drifting to the west.

On the north side of the Connoquenessing, back from Butler, the Upper Freeport coal thins away to only a few inches, and there is only one mine in operation north from the Connoquenessing in Butler township.

Along the Kearns City road, which passes out of Butler to the north-east, the smut of the Upper Freeport coal is seen at the roadside, and crossing over the hill, and descending this road to the junction of Newman's and Kearns' branches of the Connoquenessing, we get the following section of 157 feet: (Fig. 94.)

1. *Coal*, Upper Freeport,	Blossom.
2. Fire Clay,	5′
3. *Limestone*, U. Freeport,	3′
4. Sandy Shales,	20′
5. Massive Sandstone (Butler),	25′
6. Smut of Coal, or Black Shale,	—
7. Fire Clay,	5′
8. Sandy Shales,	20′
9. *Coaly Shales*, Lower Freeport, makes a big Smut in the road,	5′
10. *Limestone*, Butler (L. Freeport),	4′
11. Concealed to the level of the Connoquenessing,	60′

At this locality the Upper Freeport coal was once opened, but found to be only 1 to 1½ feet thick. The U. Freeport

Limestone is seen in the road below it, and is here a mass of bluish-white, rather compact nodules.

No. 6 makes a slight smut in the road, and may be either a small coal or bituminous shale.

The *Lower Freeport coal* makes a broad, black band across the road, and is seen to be quite slaty.

At the roadside below we see the *Butler Limestone*, which is very compact, and breaks with a sharp, clean fracture. It contains much iron, as usual.

An *oil well* was once sunk at Butler, down near the mill of Woldo & Bros., to the depth of 1,750 No oil was obtained, and no record could be procured, but Mr Charles E. Hart informs me that after passing through all the oil sands, the last 200 feet was drilled through a "blood red slate." The well commenced about 100 feet below the Upper Freeport coal.

14 Summit Township, Butler County

This lies directly east from Butler and north from Jefferson. Its eastern part constitutes the water-shed between the two Buffaloes and the Connoquenessing. Newman's branch of the Connoquenessing enters it from the north, near its north-east corner, and flows south and west across it to its western border, where it unites with the Kearn's branch to form the main stream Coal run flows across its south west border into the Connoquenessing at Butler, and Little Buffalo takes its rise in its south-west corner

A *subordinate anticlinal axis* crosses this township near the middle of its eastern line, though the precise point could not be made out owing to paucity of exposures The strata rise quite rapidly east and south from Butler for some distance, as the Upper Freeport coal does not pass under Coal run until near its head.

Two miles above Butler, on the Kearns' branch of the Connoquenessing, a coal comes to the surface, and where mined by Mr. Kearn, shows the following: (Fig 95.)

1.	(?).	1. Coal,	8''	2' 8½''
		2. Slate,	½''	
		3 Coal,	2'	
2.	Concealed to the creek,			7'

There is much doubt as to whether this represents the Darlington or Kittanning, since there are no exposures for one mile on either side, and the last stratum seen is the Butler Limestone, 60 feet above the creek, ¾ miles below; so that it is certain it is either the Darlington or Kittanning, with the probabilities in favor of the former. The coal is quite pure, being very rich in bituminous matter, containing alternate laminæ of pitchy bitumen and mineral charcoal. It contains very little sulphur, visible to the eye at least, and is an excellent coal for smiths' use It is much preferred for every purpose to the Upper Freeport at Butler, and it is unfortunate that it is exposed at only this locality; for above, it dips to the north-west and passes below the stream, and below it goes under, in following it down the same This is very probably the coal struck in the boring of Mr. Muntz, at Butler, 60 feet below the surface of the water, and reported from the boring as six feet thick.

Passing up Newman's branch of Connoquenessing we find not a single exposure until we go 1½ miles above its mouth, where the little run puts into its right bank on the land of Mr. Stevenson. Here the smut of the *Lower Freeport coal*, with its *limestone* below, is seen in the road about 30 feet above the creek, and ¾ miles above it was once mined down near creek level by Mr. Robert Stevenson. It is reported to have been 3 feet thick, but quite slaty and almost worthless.

Above this, a short distance, at Brinker's mill, we see the following section of 75 feet: (Fig 96.)

1. *Coal*, Upper Freeport, . . .	3′
2. Concealed,	40′
3. Massive Sandstone, Butler, .	20′
4. Sandy Shales, seen, ...	5′
5. Concealed to level of the creek below the dam,	7′

Here the *Upper Freeport coal* was once mined on the land of Mr. Bartley, but has long since been abandoned, and nothing but the old drift can now be seen. It is reported to have been 3 feet thick, however, though quite sulphurous and slaty.

Three fourths of a mile above the mill the Upper Freeport coal is mined on the land of Mr. Keeling, and here we get the following section: (Fig. 97)

1. *Coal*, Upper Freeport,	1. Coal, .	1′	2′ 4″
	2. Slate,	¼″	
	3 Coal,	5 ″	
	4 Slate,	¼″	
	5. Coal, .	1½″	
2. Fire Clay, seen,			. 2′
3. Concealed to level of the creek, .			. 100′

This coal is quite bad, being slaty and sulphurous, and hardly worth taking out. On the opposite side of the creek this coal is mined by Mr George Fisher, and there the coal is much better than at Keeling's, showing a section like the following: (Fig. 98.)

1. Coal,	Upper Freeport,	2′ 8″	3′ 2″
2 Slate,		1″	
3. Coal,		5″	

Though here it has much less slate and sulphur than at Keeling's, yet it still contains enough sulphur to burn out a grate in a short time.

Mr. McMullen also mines the coal near Mr. Fisher's, where the *limestone* is seen below it in the drain, according to the statement of a miner.

Oil Field of Carbon Centre.—Three fourths of a mile above where the Kittanning pike re-crosses Newman's branch, we come to the newly discovered oil territory around Carbon Centre. The hills are already dotted with derricks. The Upper Freeport coal is mined there to some extent. The Third Sand horizon of the oil lies from 1,650 to 1,675 feet below the Upper Freeport coal

The best well is "Ford, No. 1," which is now yielding * twenty-five barrels per day. When first struck it pumped one hundred. The derrick stands 75 feet below the Upper Freeport coal, and it gets the oil at 1,600 feet. No paying wells have been struck south from "Ford, No. 1," although a number have been drilled, as the sand seems to thin away entirely at this point

Returning to Butler, and passing up Coal run, along the Butler Branch railroad, we see no coal mined or any exposures, until we come near Sunset station, where we get the following section of 102 feet: (Fig. 99.)

---

* This was written in 1876.

1. *Coal*, Upper Freeport,		2½′ to 4′
2. Concealed,		30′
3. Massive Sandstone, Butler,	(Upper Freeport).	25′
4. Shales,		2′
5. *Coal*, Lower Freeport,		1′
6. Fire Clay,		2′
7. *Limestone*, Butler,	(Lower Freeport)	3′
8. Concealed to level of Coal run,		35′

Here the Upper Freeport is mined by Mr. Easterling. It is quite variable, running from 2 to 4 feet, and, in some directions, thinning away almost entirely

The Lower Freeport coal is only one foot thick, and occurs down near the railroad, with the Butler Limestone below it.

The Butler Sandstone is tolerably massive, and has been quarried extensively along the railroad track. It is a very hard grayish-white rock, and is seen finely exposed in a cut near Sunset station.

A short distance above the station, the Upper Freeport coal is seen, 2½ feet thick, in a cut, and 20 feet above the track, which it soon sinks beneath, as the track is rising quite fast to the east from this point.

Two and a half miles above Butler, Coal run branches into three forks, and, on the southern one of these, the Upper Freeport coal is mined on the land of Mrs. Lyon, where we see the following section: (Fig. 100.)

1. Sandy Shales,			10′
2. Coal, Upper Freeport,	1. Coal,	2′ 8″	3′
	2. Parting,	½″	
	3. Coal,	4″ to 5″	
3 Fire Clay,			5′
4. Limestone, (Upper) Freeport,			5′

The coal is tolerably fair, and has been mined extensively for local use.

The limestone has been quarried and burned here. It slacks with difficulty, however, owing to impurities, such as iron and earthy matter Above the coal 100 feet, the *Buffalo Sandstone* is seen, in a massive ledge, and it is quite conglomeratic. Huge masses of it are scattered over the surface below

On the middle branch of Coal run, the Upper Freeport is mined on the land of Judge McJunkin, where the coal is from 2½ to 3 feet thick, and is not very pure, containing considerable slate and sulphur. Mr. Spawn has it opened east just above this point

Passing up the railroad from where the coal goes under, above Sunset station, we see 165′ of rocks in the following order: (Fig. 101)

9. Coal in Summit cut, near Brinker's station,	6″
8. Dark Shales, with Fire Clay,	20′
7. Massive, coarse, Conglomerate Sandstone, Buffalo,	50′
6. Sandy Shales,	20′
5 Fire Clay,	8′
4 Sandy Shales,	40′
3. Sandstone and Shales, (Mahoning) .	20′
2. Sandy Shales,	10′
1. *Coal*, Upper Freeport,	2′ 6″

No 7 is quite massive, and is finely exposed along the railroad track, where it was cut through in getting the grade.

No 9 is seen in the cut at the summit, near Brinker's station, where it is quite impure, and coated with crystals of copperas. This is the coal which is frequently seen above the Buffalo Sandstone

Herman Oil Well—Two miles east from Brinker's station, at Herman, we come to the oil-boring of the Herman Oil Company.

The well commences 40 feet above the level of Herman station, and, though no regular record was kept, the driller gave me the following items concerning it:

The first coal was struck at 120 feet, the second at 325 This is the Upper Freeport. The Ferriferous Limestone at 548, the First Sand at 1,425 feet, and the Third Sand at 1,835, where a little oil was obtained, and much salt water.

15. *Clearfield Township, Butler County.*

This is the north-eastern township of the district, and is bounded on the west by Summit, and on the south by Winfield It is drained by the tributaries of Big Buffalo, which rise in its western part, and flow east into the Big Buffalo, near the eastern border of the township. Rough and Corn Planter's runs also head up in its southern portion.

At the head of the West Branch of the Big Buffalo, the Upper Freeport is mined on the land of Mr. Humes

It is there seen down near the level of the creek, where the Butler and Kittanning Pike crosses the stream, and is 3 feet 8 inches thick, with the Freeport Limestone below it. The coal is quite good, being brilliant, clean, and nice looking This coal is also mined a short distance below by Mr. Kramer Here is the present terminous of what is called the Eastern Oil Belt. There are two wells on the land of Mr. Humes, which pump together 1,000 barrels per month. They start at the horizon of the Upper Freeport coal, and get the oil at 1,680 feet

Descending this stream to the east, the strata rise quite rapidly, and the stream falls equally fast, so that the Darlington coal is soon brought up, and has been mined at several points along the stream, though very few banks are now in operation. But going down to one and a half miles above the mouth of the West Branch, we find both the Darlington and Kittanning coals mined on the land of Mr. McDevit, where we see the following section of 112′: (Fig 102)

1. Sandstone, Freeport, seen,			10′
2. *Coal*, Darlington, ...			3′ 8″
3. Concealed, ...			70′
4. *Kittanning Coal,*	1. Coal, .	2′	8′
	2. Shale,	. . 1′	
	3. Coal,	2′ 8″	
	4. Shale, .	. . 8″	
	5. Coal, . . .	2′	
5. Concealed to creek, ...		.	20′

Here the Freeport Sandstone is somewhat massive, and is exposed for a few feet over the coal. Mr. McDevit says it forms the roof of the coal in a solid mass further back.

The Darlington coal is quite pure, being oily, pitchy, black and lustrous. It is said to be an excellent smithing coal. The Kittanning coal, has here split up into 3 beds, separated by shales and fire clay; the upper somewhat slaty, the middle excellent, the lower not quite so good.

One half a mile below this, the Kittanning coal is mined by Mr. Deener, who strips it out of a little bottom, along the roadside It there shows the same division into three beds, which is seen at Mr. McDevit's, above. One mile below this the same coal is stripped on the bank by Mr. Dipner. Here it also shows the same splitting up into three beds, with fire clay, and shale between All along the creek, a very massive Sandstone is seen below the Kittanning coal.

On the little run which comes in from the south at the junction of the West Branch with the Big Buffalo, we see the following section of about 260′: (Fig. 103.)

1. Massive Sandstone, Butler, seen,.			15′
2. *Coal*, Lower Freeport,			?
3 Iron ore,			?
4. *Limestone*, Butler,			?
5. Concealed,			80′
6 *Coal*, Darlington,			3′
7. Concealed,			70′
8. *Kittanning Coal*,	1. Coal,.	4′	10′ 9″
	2. Slate,	1′ 6″	
	3. Coal,	2′ 6″	
	4. Shale,	3″—4″	
	5. Coal, .	2′ 6″	
9. Concealed to the creek,.			70′

Here the *ore on the Butler Limestone* was once stripped out on the hill and taken to Buffalo Furnace on Big Buffalo and Winfield furnace on Rough run.

The ore drift is now covered up, and neither the ore, the coal, nor the limestone can be seen, yet blocks of each are seen on the dump. The limestone is quite earthy and impure, and is called the Bastard Limestone by the people

Nothing could be learned of the thickness of the coal or ore, as it has been a long time since either has been mined. The Darlington coal has been mined on the land of Mr. Morrow, who reports it as very good, though the mine is not now in operation, and I could not see the coal.

The Kittanning is here a huge bed. The thickness of the upper part was given to me by one of the miners, who said he had measured it at a place where the roof had fallen in. This part of the bed is left for the roof, being somewhat slaty; the middle and lower yield an excellent coal.

It comes out in long slender blocks like a splint coal, and is very pure and good The coal from this bank (Mr Morrow's) has the best reputation of any in the neighborhood. The coal dips very rapidly to the north-west, as it is just over the crest of the Fifth Axis; it falls 50 feet in ¼ of a mile.

The massive Sandstone is seen below the Kittanning coal at the bridge, near Mr. McClelland's, who sank a well down into it for 17 feet. Here, at the bridge, the Ferriferous Limestone is near water-level.

One fourth of a mile below where the last section was made, we see the following near the Armstrong county line on the land of Mr. McClelland, 105′. (Fig 104.)

1. *Coal*, Kittanning, "reported,"	3′
2. Concealed,	30′
3. Massive Sandstone,	20′
4. Concealed,	5′
5. *Limestone*, Ferriferous,	15′
6. Shales,	20′
7. *Coal*, Clarion,	2′
8. Concealed to level of Buffalo,	10′

No 1 is the same coal which is opened ¼ of a mile above, at Mr. Morrow's, and is there 11 feet thick; here, however, Mr. McClelland reports it as only 3 feet thick, and single, it having resumed its normal character.

The Ferriferous Limestone is seen in a massive cliff extending around the bluff at this point, and dipping rapidly down to the north-west as the Fifth Axis crosses Buffalo a short distance below. It presents its usual peculiarities of lithology and fossils. The Clarion coal was once mined under it, but has long since been abandoned.

The Fifth Axis crosses Long's run in the south-eastern part of the township, one half mile above where that stream enters Winfield, and there brings up the Kittanning coal and Ferriferous Limestone. The coal is stripped out of the creek by Mr Carr, on the property of the Winfield Furnace Co., where it is quite good, and 3′ thick.

Just below where the road crosses Long's run we have: (Fig. 105.)

1. Shales, seen,	5′
2. *Coal*, Kittanning,	3′
3. Concealed,	40′

4. Massive Sandstone, seen,	10′
5. Shales, containing Iron Ore,	5′
6. *Limestone*, Ferriferous, seen to the bottom of the run, .	5′

Here was an old drift in the Kittanning coal on the Winfield Company's property. The shales above the Ferriferous Limestone contain iron ore, and it was stripped out and taken to the Winfield Furnace.

CHAPTER IX.

ALLEGHENY COUNTY.

16. Fawn Township.

This lies immediately south from Butler county, and is bounded on the east by the Allegheny River, and on the west by East and West Deer townships.

It is drained by Big and Little Bull creeks, which enter it from Butler, and flow south through it into the Allegheny river, at Tarentum. Little Bull creek flows almost parallel to the Allegheny river, throughout its entire course, from which it is separated by only a high ridge. The banks of the Allegheny, along this line, receive no tributaries, except small streams, which plunge down from the tops of the hills

Big Bull creek enters the township from Butler county, near its north-western corner, and flows south-east along its southern border, and uniting with Little Bull creek, three fourths of a mile above Tarentum, empties into the Allegheny river at that place.

All the northern part of the township is covered by the Lower Barrens, which extend upward 100 feet above the Crinoidal Limestone.

Little Bull creek, on entering Allegheny county, begins to cut down through the massive Sandstones at the base of the Lower Barrens, and here the sides of the stream begin to steepen, and, instead of a broad level valley on either side, as there is along its course in Butler county, it flows in a narrow gorge with almost perpendicular walls on either side.

At Burke's mill, the massive Buffalo Sandstone is seen in a huge cliff extending along the hillsides, from which immense blocks have tumbled to the valley below. Its base is there 100 feet above the creek, and the Mahoning Sandstone is seen along the stream, though not nearly so massive a rock as the Buffalo.

Two miles below Burke's mill, at the mouth of Negley's run, the Upper Freeport coal comes to the surface, and there we get the following section of 133 feet in descending the steep hillside to its base: (Fig. 106.)

1. Massive Sandstone, Buffalo—top of it seen.			
2 Concealed,			50'
3 Sandy Shales,			15'
4. *Smut of Coal, Brush creek,*			?
5. Concealed,			55'
6. Sandy Shales,			5'
7. *Coal*, Upper Freeport,	1. Coaly Slate,	6''	3' 8''
	2 Coal,	2' 10''	
	3 Slate,	1''	
	4. Coal,	3''	
8. Fire Clay to bottom of creek,			4'

The coal is here mined on the land of Mr. Burtner. A steepening of the dip brings it to the surface for only a few rods, as it immediately passes under the stream, both above and below. The coal is quite fair, though containing some pyritous streaks. The bottom division is not taken out, as it is slaty and impure.

The smut of the Brush creek coal is seen 60 feet above the Upper Freeport coal, and, if anything can be judged from its blossom, it is about 2 feet thick. Just below this, the dip of the rocks exceeds the fall of the stream, and the Upper Freeport coal passes under and is seen no more, until we come to the Methodist camp meeting ground, where it again comes up, and is mined a short distance below by Mr Pugh, on whose land we get 180 feet of rocks descending the steep hill above his coal drift: (Fig. 107.)

1. Massive Sandstone, Buffalo,			25'
2 Concealed,			90'
3 Sandstone, somewhat massive, Mahoning,			25'
4. Sandy Shales,			5'
5. *Coal*, Upper Freeport,	1 Slaty Coal,	5 ''	3' 6''
	2. Coal,	2' 9 ''	
	3. Slate,	½''	
	4. Coal,	3 ''	
6. Fire Clay,			4'
7. Sandstone,			8'
8. Coaly Slate,			1'
9. Sandy Shales,			2'
10. *Limestone*, Freeport,	1. Limestone,	2'	7'
	2. Shale,	1' 3''	
	3. Limestone,	2'	
	4 Shale,	3''	
	5. Limestone,	1' 5''	
11. Concealed to the creek,			10'

Here the Buffalo Sandstone is seen forming a ledge of cliffs along the steep hill-side.

The Mahoning Sandstone is also massive, and is seen in a perpendicular wall above the coal At one place it is split up by layers of shale at intervals of 3 to 4 feet.

The Upper Freeport coal is mined quite extensively by Mr. Pugh, for local use It contains some sulphur, but makes an excellent domestic fuel

Proof of change of level in the Coal Era:—

Here we have a fine example of local subsidence during the epoch of the Upper Freeport, for the Limestone is separated from the Coal by 15 feet of Sandstone and Shales, whereas, its proper place is immediately under the Fire Clay. The Section shows that an attempt was made at *coal making* at the proper horizon for the Upper Freeport coal, but this was interruped by a sudden subsidence of a local nature, after which the sinking ceased and the coal marsh again spread over the accumulated sediment.

The Freeport Limestone is quarried and burned by Mr. Pugh It is separated into three layers by shales, as seen in the section The middle layer is the best and purest stone for burning, as the upper contains too much iron, and the lower is somewhat earthy.

At the mouth of Little Bull creek, the Upper Freeport coal is mined by Mr. Leslie, at an elevation of 130 feet.

Just below the mouth of this creek, and on the right bank of Big Bull creek, the coal is mined by Mr. Hare, at whose drift we get the following: (Fig. 108.)

1 Sandy Shales,		8′
2. Slaty Coal,	1′	4′ 4″
3. Coal, good,	3′	
4. Slate,	0′ 1″	
5. Coal,	0′ 3″	

The coal is very bright and clean, lustrous, and quite good; occasional streaks of sulphur are seen in it. The bottom 3 inches is not taken out, as it is very impure, being filled with pyritous slate.

Descending Bull creek from this point to its mouth, the coal dips very rapidly to the south-east, and at Tarentum is only 80 feet above the river, while at the mouth of Little Bull creek, it is 140 feet above that stream.

Passing up Big Bull creek, the Upper Freeport coal is frequently seen, where old openings have been made in it and abandoned One mile above the mouth of Little Bull creek, the following is exposed on the land of Mr Bandy. (Fig. 109.)

1 *Upper Freeport Coal*,	4′
2. Fire Clay Shales, and concealed,	12′
3 *Limestone*, Freeport,	5′
4 Concealed,	45′
5. *Coal*, Lower Freeport,	1′ 6″
6 Concealed to the creek,.	40′

Here the Upper Freeport was mined at one time and is now abandoned

The Freeport Limestone was once quarried and burned, and a drift was also made on the Lower Freeport coal, but it proved quite slaty and worthless, and only 1½′ to 2′.

One and a half miles above this McDowell's run enters Bull creek, and just below the mouth, an Axis with a very sharp westerly dip crosses Bull creek, causing the coal to drop 40 feet to the north-west in about 25 rods. Just below the mouth of this stream the Upper Freeport coal is opened at the roadside by Mr. Woodrow, and there we get the following section of 101 feet: (Fig. 110.)

1. Sandy Shales,				15′
2.	1. Slaty Coal,	11″	Coal, Upper Freeport, .	4′ 9″
	2. Coal,	3′ 0″		
	3. Slate, .	¼″		
	4. Coal,	5″		
	5. Slate,	1″—2″		
	6. Coal,	2″		
3 Fire Clay,			.	3′
4. Concealed,				11′
5 Limestone, Freeport, seen,			.	2′
6 Concealed to creek level,			. . . .	65′

Just around on the other side of the hill the coal is lower by 40′, in 25 rods, to the north-west, and is only 10 feet above the level of McDowell's run, where the road crosses it above its mouth. It is worked by Messrs. Kennedy, Simmons, Hill, and others. One fourth of a mile above its mouth, the coal passes under the stream, dipping rapidly to the north-west The last opening in it, before it passes under, is Mr. McDowell's, and descending the steep hill there we see the following section of 173 feet: (Fig. 111)

1. Massive Sandstone, Buffalo,			50′
2. Concealed,			50′
3 *Smut of Brush Creek Coal*			
4 Concealed,			15′
5. Row of Limestone Nodules			
6. Sandy Shales and Sandstone,			45′
7. *Coal*, Upper Freeport,	1 Slaty Coal,	6″	4′ 2″
	2 Coal,	3′ 0″	
	3. Parting,	¼″	
	4. Coal,	4″	
	5. Slate,	1″	
	6. Coal,	8″	
8. Fire Clay,			3′
9. *Limestone*, Freeport, seen,			2′
10 Concealed to the bed of the run,			4′

No. 1 is the Buffalo Sandstone, which is not so massive here as usual, but large blocks are seen scattered about.

No. 3 probably represents the Brush creek coal. Mr. McDowell informs me it was one foot thick where he dug into it on the other side of the run.

Johnstown Ore?—No. 5 is a small nodular limestone, about ½ foot thick, and contains much iron

The coal is very sulphurous, and burns out a grate in a short time Besides much pyritous slate, it contains many large sulphur binders scattered through the coal.

The upper part only of the Freeport Limestone, is seen. It has been burned by Mr. McDowell, who reports it as making an excellent lime. Below here where the road crosses this run, it is seen in the bank of the road in three or four layers.

On the main branch of Bull's creek, the coal goes under the stream, one fourth of a mile above the mouth of McDowell's run, just above where the road crosses it, and has there been mined by Mr. Goldinger, but it is too low to drain, and is now abandoned.

The north-west dip continues only one half mile above where the coal goes under, and when the coal is about 40 feet below water level, the dip is reversed, and the strata rise to the north-west, as we pass up the stream.

The little coal, which comes 60 feet above the Upper Freeport, is constantly seen along the road, at about the same elevation above the stream from this point up to Millerstown, the strata rising about as fast to the north-west as the bed of the stream.

On the Lardintown branch of Bull creek, the Upper Freeport coal is kept under until we come to the Butler county line, where it comes up exactly on the line, the mouth of McGinnes' bank being in the edge of Allegheny county

At Millerstown the Brush creek coal is seen near the blacksmith's shop, and also along the bank above the mill It is there about 40 feet above the creek, and is a mixture of slate and impure coal. Under it comes a large bed of fire clay. The Upper Freeport coal should not be more than 25 feet below the creek at Millerstown

Ascending the stream from this point, the strata rise quite rapidly, and, three fourths of a mile above the village, the the Upper Freeport coal is brought up above water level, on the land of Mr Thomas White, who once mined it, but, being difficult to drain, it is now abandoned.

At Dawson's mill, the blossom of this coal is seen in the steep bluff, and, 3 feet below it, comes the Freeport Limestone, and 10 feet below the Limestone is seen a very massive sandstone, which comes at the horizon of the Butler Sandstone.

The coal was once mined near the edge of this township by Mr Marshall, but the works are now abandoned, and the entry fallen in.

17. East Deer Township, Allegheny County.

This lies south from Fawn, and east from West Deer and Indiana. It is a long narrow strip, and like Fawn has the Allegheny river for its eastern boundary.

No large streams cut through it, but it is drained by small streams which rise along the western border of the township, and descend with a rapid fall to the Allegheny river.

Owing to this highland character of the township, the Lower Coal Measures are seen only along the Allegheny river and for a short distance up the streams.

Oil and salt water horizon of Tarentum:

One and a half miles below Tarentum are the old salt-works of Peterson & Co Here, in early days, much salt was made, and, with the salt (which comes 400 feet below the Upper Freeport coal) considerable oil was obtained; in fact, so much, that it became a nuisance, and a shaft was sunk to see if it could not be abated; but, of course, the oil would rise with the water, and the project was abandoned.

On Day's run, two and a half miles above the mouth of Robinson, we find a coal mined in the Lower Barren Series by Mr Wilson, and there we get this section of 150': (Fig. 112)

1.	Sandstone,		6'
2	*Coal*, Slaty,	Berlin Group.	2' 8''
3.	Concealed,		70'
4	Sandstone, Shaly,		10'
5.	Shales,		5'
6.	*Coal*,		2' 6''
7.	Fire Clay,		6''
8	Black and Chocolate-colored Shales,		10'
9	Massive Sandstone, seen,		10'
10	Concealed to the creek,		30'

Nothing can be affirmed definitely as to the horizon of these two coals, except that they are near the middle of the Lower Barrens, no limestone or other rock occurs in connection with them by which we can assign them a definite horizon in the series. The upper one was once opened here, but is very slaty and worthless, and was mined very little.

The lower one is, however, an excellent coal, as there is very little sulphur in it, and it has the structure of a *block* coal Its only fault is a little too much ash, or it would make an excellent furnace coal. This is, in all probability, the coal which comes immediately above the Buffalo Sandstone, and which is seen at the summit cut in Butler county, near Brinker's station.

On Day's run, the Upper Freeport coal comes up one half mile above its junction with Robertson's run, and was once opened there, but is now fallen in and abandoned

Here 10 feet below it is seen the Butler Sandstone in very massive conglomeratic layers.

Just below the mouth of Robertson's run are the *salt-works* of the Bailie Brothers. Their wells commence 20 feet below the Upper Freeport coal, and they strike the salt water at two horizons, 365 to 385 feet. That at 365 is the most abundant, but only 6° strong, while that at 385 is 12°. Some oil is obtained at the latter horizon. Both these water strikes occur in the Piedmont Sandstone or top member of the *Pottsville Conglomerate.*

The Ferriferous Limestone, 12 feet thick, was struck at 252 feet, and it would then be 272 feet below the Upper Freeport at this locality.

The Upper Freeport coal is mined by the Bailie Brothers, and shows the following section: (Fig. 113.)

1 Cannel Coal,.	2'	
2. Bituminous Coal,	2' 9"	
3. Slate and Bony Coal, .	8"	
4. Coal,	2' 10"	
5. Parting,	¼"	9' 6"
6 Coal,	4"	
7. Parting,	¼"	
8. Coal,	1'	
9. Fire Clay,		½'
10. Massive Sandstone, Butler.		

Here the top layer is an impure *cannel*; it is seldom mined, being left for the roof. It burns quite well, however, as I was informed by Mr. Bailie.

The bed is duplicated at this locality, No. 3 being the usual top of the coal. This No. 3 is a black slate mixed with bony coal This bed is quite a superior coal, containing very little sulphur, and being rich in bituminous matter It rests directly upon a very massive sandstone, which is probably the Butler, and the *limestone* which should come below it is *cut entirely away;* but only a short distance down the run the sandstone is seen to fine down into shale, and the *limestone appears* in its proper horizon.

A short distance below Bailie's, the same coal is mined quite extensively by Mr. Hite, at Hitestown, and there gives us the following section: (Fig. 114.)

1. Cannel,	2'	
2. Coal,	3'	
3. Bony, Slaty, Coal,	0' 7"	
4. Coal,	3'	
5. Parting Slate,	0' ½"	10'
6. Coal,	0' 5"	
7. Parting,	0' ¼"	
8 Coal,	0' 10"	

The coal is also of excellent quality here, and is shipped on a large scale to the manufactories and furnaces at Pittsburg. No. 8 is called the *Brick coal*, from its coming out in rectangular blocks resembling bricks *

This great development of the Upper Freeport coal commences about one half mile above Hitestown, for above that it is single bedded and only 4 feet thick.

This duplication of the bed was seen once in Butler county, near the head of Bull creek. The coal dips very rapidly to the south-east here, and where the road crosses Hite's run, above its mouth, it is in the bed of the stream; one fourth of a mile below, it passes under the bed of the Allegheny river, to be seen no more descending that river

The rest of the township, south from Hite's run, is occupied exclusively by the Lower Barren Measures, which extend far up above the Crinoidal Limestone, but which afford nothing new or of particular interest

Passing up Hites' run, the *Pine creek limestone* is seen coming down to the bed of the stream, one mile above its mouth, and 180 feet above the Upper Freeport coal. It is an impure iron ore at this locality. Forty feet above it are seen some black bituminous shales, which probably represent the *Bakerstown* (*Coleman?*) *coal.*

Near the head of Hites' run, we come to a coal, 3½ feet thick, on the land of Mr. Simon It has been mined extensively by stripping, and, also, by drifting, and is a very good coal. It is 360 feet by the barometer above where the Upper Freeport coal was last seen at Hitestown, which would bring it at the horizon of the Elk Lick.

Above it, 40 feet, is seen a small coal, and 20 feet above that comes a very large black streak of coal, or very bituminous shales.

18. West Deer Township, Allegheny County.

This lies west from Fawn and East Deer, and adjoins the Butler county line.

It is drained by Big and Little Deer creeks, both of which rise on its northern slopes; the former draining its western part, and the latter its eastern.

---

* Totally different from the "Brick bench" of the Pittsburg Bed.

The Fifth Axis passes through it west from the center, and along its crest it brings up the Upper Freeport coal on Bull creek, and on Big Deer, where it crosses that stream.

The *Pittsburg coal* is caught on a very high knob, one half mile west from Little Deer creek, near the southern line of the township; with these exceptions the surface is occupied entirely by the rocks of the Barren Measures.

In its north-eastern part, the Upper Freeport coal is mined along the head waters of Bull creek, and at Mr. Brewer's bank we get the following: (Fig. 115.)

1 Cannel, impure,	2'	10' 6"
2 Coal,	2' 8"	
3. Shale,	1' 6"	
4. Slaty Coal,	1'	
5 Coal, good,	3'	
6. Parting Slate,	½"	
7. Coal,	5"	
8. Fire Clay,		2' 6"
9. Limestone, Freeport,		2' 6"

The coal shows a structure similar to that seen at Hitestown, below Tarentum, in East Deer township.

Only the lower part of the bed has ever been mined, the upper being somewhat slaty, and the cannel is too impure to burn well. The lower part of the bed is, however, a tolerably good coal, though containing more sulphur than this coal contains at Hitestown.

There have been a great many openings at this locality, which is called "Coal Hill." This is the last opening as we ascend this branch of Bull creek; for the coal passes under the stream a few rods above Brewer's bank, still rising to the north-west, though the Fifth or *Brady's Bend* Axis crosses only 40 rods west from Brewer's bank.

Descending the stream, we find the coal mined by Mr. Diamond, and also by Mr. Dawson, near the mouth of Brewer's run; and at the pumping station of the Columbia Conduit Company it is mined by Mr. W. Dawson, where it shows the following section: (Fig 116)

Coal, Upper Freeport,	1. Coal, Slaty,	6 "	4'
	2. Coal,	3' 0 "	
	3. Parting,	0' ½"	
	4. Coal,	0' 5 "	

The coal is clean, brilliant, and much freer from sulphur than usual. This is just above where the creek enters East Deer township The coal has now regained its normal thickness.

Near Culmerville Post Office, a small coal is seen 160 feet above the Upper Freeport This is one which comes above the Buffalo Sandstone, and which is frequently seen at that horizon. (See page 32.)

The Fifth Axis passes a short distance west from Culmerville ; but Little Deer creek does not cut down deep enough to reach the coal where the Axis crosses it Passing down Little Deer creek, the rocks dip quite rapidly to the south-east, but there are very few exposures, and nothing of importance to expose, as we are in the middle of the Barren Measures.

The *Crinoidal Limestone* is occasionally seen in the hills with its underlying bed of red clay.

A *massive sandstone* is seen exposed near the creek at Gray's mill.

The smut of a coal is seen 240 feet above it, ascending the hill road toward East Deer township ; but above this we see nothing but red, brown, and buff shales for 200 feet.

On Big Deer creek the Fifth Axis crosses one fourth of a mile above the mouth of Dawson's run, and there just brings the *Upper Freeport coal* to the surface in the creek bed, when it again plunges down to the north-west.

One half mile below this, the coal is mined by Mr Joseph Martin, and we see the following in his slope, which reaches the coal 10 feet below the level of the creek: (Fig. 117.)

1. Sandstone,			2'
2. Shales,			2'
3. Coal, Upper Freeport,	1 Coal,	1' to 4 '	6' to 9'
	2. Bony Coal,	1' to 1½'	
	3. Slate,	3 " to 4"	
	4. Coal,	3'	
	5. Slate,	¼"	
	6. Coal,	6 "	
4. Fire Clay,			3'
5. Limestone, Freeport,			?

The upper part of the bed is reported by Mr. Martin to be quite variable, sometimes suddenly thickening up to 4 feet, and again running down to 1 foot or less

No. 2 is a bony, slaty coal, which is always too impure to burn, and is thrown on the dump.

No. 4 is the best coal in the bank; it contains some sulphur, but not enough to injure it for domestic purposes. Mr. Martin sells about 25,000 bushels per annum, as he supplies a wide territory to the west and south with coal.

The Upper Freeport limestone occurs below the coal, Mr. Martin informs me, but he never dug through it.

No other works are in operation in the neighborhood, as the coal cannot be mined except by shafting

19 *Indiana Township, Allegheny County.*

This lies south from West Deer and west from East Deer. The principal draining stream is Big Deer creek, which enters it from the north and uniting with Little Deer, flows two and a half miles, and at Harmersville, enters the Allegheny river, which washes the southern shore of the township.

No member of the Lower Coal Series is brought to the surface in this township; for the Fifth Axis passes by to the west from it, but in the trough east from this Axis some outlying areas of the *Pittsburg coal* are caught in the highest knobs near the northern part of the township, just west from Little Deer creek, between it and Log run.

One fourth of a mile south from the northern line of the township the *Pittsburg coal* is mined on the land of Mr. William Marshall, at whose drift we see the following: (Fig 118)

Pittsburg Coal,	1. Slaty Coal,	2′ 0″	Roof,	3′	8′
	2. Shale,	3″			
	3. Coal,	5″			
	4. Shale,	3″			
	5. Main Bench Coal,			3′ 4 ″	
	6. Bearing-in Coal,	1. Slate, ¼″ 2. Coal, 5 ″ 3. Slate, ¼″		5½″	
	7. "Bottom Coal,"			1′ 3 ″	

The coal being near the surface is, of course, greatly deteriorated in quality and quite dry and slaty near the out-crops, but in under the center of the knob the coal is very good, and comes out in handsome blocks.

The bottom bench is rather impure, containing much pyritous slate. It is taken out, however On the top of the knob above the coal we see some huge blocks of a very massive sandstone The knob rises only 40 feet above the coal at its highest point, and these are remnants of the *Pittsburg Sandstone.* They are quite coarse and massive. Under the coal about 30 feet is seen a whitish limestone one and a half to two feet thick

The William Marshall tract contains about ten acres of the Pittsburg coal.

Just south from this the coal is mined on the land of Mr J. Marshall by Mr. Johnston This is the largest single area in the neighborhood, and contains about 20 acres. The section there is the same as at Marshall's.

A short distance south from this is another area of about 10 acres in the top of a knob, also operated by Mr. Johnston, and the section there is as follows · (Fig 119.)

Pittsburg Coal,	1. Slaty Coal,		2' 6"	Roof Coal,	3' 7"	7' 9"
	2. Shale,		3"			
	3. Coal,		6"			
	4. Shale,		4"			
	5. Coal, Main Bench,				3' 2'	
	6. "Bearing-in,"	1. Slate,	¼"		7"	
		2. Coal,	6 "			
		3. Slate,	½"			
	7. "Bottom" Coal,				1' 5"	

The coal is very near the surface and is rather inferior. The roof division is slaty and is not taken out.

Three fourths of a mile south from here we get another small area in the summit of a knob on the land of Mr. Lefever It was once mined, but the opening is now abandoned and fallen in. This is the last patch to the south near here, as, the dip having changed, the coal is carried above all the neighboring hills in that direction until we come down near the mouth of Deer creek.

Passing down to Little Deer creek we find the *Crinoidal Limestone* at an interval of 300 feet below the Pittsburg coal, and 100 feet above the stream on the west side.

On the east side of the creek, near Mr. Conahy's, a very high knob extends up almost to the Pittsburg coal, and descending it to the creek we get 433′ of rocks thus: (Fig. 120)

1 Concealed from top of the knob,		40′
2. *Limestone* (Pittsburg),		2′
3. Concealed,		230′
4. Shaly Sandstone, seen,		6′
5. *Coal*, Slaty, Elk Lick,		1′ 6″
6. Concealed,		80′
7. *Limestone*, Crinoidal,	1. Limestone, 1′ 2. Shale, 0′ 4″ 3. Sandstone, 1′	2′ 4′
8 Concealed,		120′
9 *Pine Creek Limestone* in bed of Little Deer Creek,		1′ 6″

No 2 is very probably the same limestone which was seen on the opposite side of the creek 30 feet below the Pittsburg coal, and in that case the Pittsburg coal should be found in the very summit of this knob, if it has not been removed by erosion It is light-gray, quite compact, breaks with a sharp, clear fracture, and would make very fair lime.

No. 5 occupies the horizon of the *Elk Lick coal*, and is rather slaty. Mr. McConahy opened it once, but found it too impure to burn

The *Crinoidal Limestone* is here the same greenish, rough looking rock, crowded with its characteristic fossils, and separated into two layers by 4 to 6 inches of calcareous shale, a thing unusual with this stratum. It has been burned by Mr. McConahy, but does not slack well.

In the bottom of the creek, a short distance below, Mr McConahy's, the *Pine Creek Limestone* is seen; quite hard, and silicious, and containing considerable iron.

A limestone 1½ feet thick, lies 180 feet below the Crinoidal, at the mouth of Little Deer creek It is rather light colored, very compact, somewhat brecciated and silicious at the top, and fossiliferous; *Lophophyllum proliferum*, and a small *Bryozoan* being especially numerous, besides *Chonetes*, *Productus*, *Spirifer*, &c.

A small coal comes a few feet below the limestone, and reddish shales above it. This is very probably the Brush creek limestone, and the coal under it, is the Brush creek coal. Immediately below the coal comes a massive Sandstone, which extends down to the bottom of the creek, 18 feet below. The limestone has been quarried here and burned by Mr. Carson, who reports it as making a very fair lime.

Crossing Big Deer creek, and descending the hill road to Denny's mill, we see 170 feet of strata above the Brush Creek Limestone, which is very well exposed. They consist entirely of reddish drab and chocolate-colored shales, interstratified with thin sandstone.

Three fourths of a mile north-west from the mouth of Deer creek, a very high knob catches the *Pittsburg coal* in its summit on the land of Mr Campbell

Passing up Big Deer creek, from the mouth of Little Deer, we see the Crinoidal Limestone exposed at the roadside, 200 feet above the creek, on the land of Mr. Cretz

A short distance below Yonker's mill, a massive Sandstone is seen above the Brush creek Limestone, from which it is separated by reddish shales At the mouth of Blue run the Brush creek Limestone is seen in the bank of the creek, above where the road crosses, and 5 feet below it is seen the smut of a coal, and then we have Fire Clay and Shales down to a massive Sandstone 12 feet below the limestone.

At Franklin's old mill, ¾ of a mile above the new one, a boring was once made for oil, and all that I could learn of it was that a bed of coal, six feet thick, was passed through at 150; probably the Upper Freeport, as the well commencd about 40 feet above the stream, and the Brush creek Limestone is there a few feet below the bottom of the creek

The Pine creek Limestone is seen in a ravine below Dorseyville, and one mile west of the village a coal was once worked on the land of Mr Weber; reported to have been 2½ feet to 3 feet thick; it is probably the Bakerstown coal, as it comes at about that horizon.

20. Shaler Township, Allegheny County.

This lies west from Indiana and south from Hampton. Pine creek passes in a very tortuous course nearly through its center from north to south, and enters the Allegheny river a short distance below Sharpsburg

Pine creek, being a large stream, cuts down deeply into the rocks, and; as we approach the crest of the Fifth Axis, the Upper Freeport coal is brought up and exposed along all the upper portion of the creek in this township

At the mouth of Pine creek, the Upper Freeport coal is 80 to 100 feet below the level of the Allegheny

The Brush Creek Limestone is seen at the roadside, near the Ætna Iron-Works It is 1½ to 2 feet thick, and is quite compact and silicious.

The rocks rise very rapidly, as we ascend Pine creek, and at the big bend in the creek, opposite the mouth of Little Pine, the *Mahoning Sandstone* is seen in perpendicular cliffs along the stream. It is very massive, and it, with the Buffalo above, keep the hills steep and rugged, and their sides are covered with a dense growth of pine.

As we go up the stream, the rocks still keep rising faster than the stream's bed, and at Shaw's mills, three miles above Sharpsburg, the *Upper Freeport* is brought above the water level, and is mined on the land of Mr. Shaw, where we get the following section: (Fig 121)

1. Sandstone and Shales,		.	20′
2. Coal, Upper Freeport,	1. Coal,	. . 3′	7′ 6″
	2. Slate and Coal,	1′	
	3 Coal,	3′	
	4 Parting Slate,	0′ ½″	
	5 Coal,	. 0′ 6″	

The coal has the same double character which we see on Deer creek, and along the Allegheny at Hitestown The upper bench is tolerably good, but contains some slate and sulphur, while the lower is an excellent coal, containing only a small proportion of sulphur and ash. It was once extensively mined and taken to the Ætna rolling-mill at the mouth of this stream. The coal is shining black, and rich in bituminous matter.

The Crinoidal Limestone is seen in the top of the hill, 320 feet above the coal.

One half mile above the mill there are other openings on the land of Mr Shaw, and they show about the same structure as the coal at the mill.

One mile above Shaw's mill, the coal is mined by Mr Miller, and there it shows the following structure (Fig. 122)

1. Slaty Coal, . .	1' 3 "	4' 8"
2. Coal,	3' 0 "	
3. Slate,	0' ½"	
4. Coal,	0' 5 "	

Here there has been quite a change in the bed, the upper bench seen at Shaw's having entirely disappeared, while the bottom part remains the same. The coal is very good

A short distance above this point the coal seems to thin down, and run almost to nothing, as there has been much searching for it, and all have failed to find any workable coal, though I learned that it was still 1 to 1½ feet thick

Just above the Nine Mile House, on the Butler plank road, this coal thickens up again slightly and is mined by Mr. Hieber, where we get the following section of 45 feet: (Fig. 123.)

1. *Coal*,	3'
2. Concealed, .	3'
3. *Limestone*, Freeport,	4'
4. Concealed to the creek,	35'

The coal is quite slaty and sulphurous, the bottom of the bed was not seen, but it cannot be more than five to six inches thicker than I have given it

The (*Upper*) *Freeport Limestone* is here a very compact, hard limestone, and contains considerable iron.

Girtie's run flows through the south-western part of this township. At its mouth the *Crinoidal Limestone* is 110 feet above the Allegheny river, which would place the Upper Freeport coal about 180 to 190 feet below the bed of the same. As we ascend the stream the rocks rise rapidly, and at the mouth of Wible's run the *Pine Creek Limestone* is brought up, and we get the following section of 123 feet on the land of Mr. Gibson: (Fig. 124.)

1. **Sandy Shales**,	10'
2. **Black Slate**,	3'
3. *Coal*, . (Local Coal on Gertie's Run)	2' to 3'
4. **Fire Clay**,	3'
5. **Shales**,	2'
6. **Massive Sandstone**,	55'

7 Shales, Sandy,	40′
8. Limestone, Pine creek,	2′
9. Shales to the level of the run,	5′

At this locality, No. 3 has been mined by Mr. Gibson. The opening is now fallen in, but he reports it as tolerably free from slate, but contains considerable sulphur. This is *a local deposit of coal*, being found only on this stream. It comes a few feet *below the Crinoidal Limestone*, probably 10 to 15 feet. It has been mined further up this stream by Mr. Wible, where it was 2 feet thick.

No. 6 is a very massive Sandstone, and is seen along the run in perpendicular cliffs

One mile below this, and near the western line of Shaler township, the Pittsburg coal comes into a hill, which rises 450 feet above the stream, and was once mined on the land of Mr Irwin. There are only a few acres of it, as the knob rises only 50 feet above the coal

On Little Pine creek, opposite Shaw's mill, the *Buffalo Sandstone* is seen in massive cliffs, 100 feet above the stream, and the surface is covered with its huge fragments.

21. Hampton Township, Allegheny County.

This lies immediately north from Shaler, and west from Indiana. Pine creek is its principal stream, and enters the township in its north-west corner, and with many abrupt bends and curves passes out of it near the center of its southern line. The channel of the stream is in many places a mere gorge, cut down through the massive sandstones at the base of the Barren Measures

Passing up Pine creek, into Hampton township, from where the *Upper Freeport* coal is seen at Hieber's bank we find it thinning out entirely; for near the mouth of Gourd-head run the Freeport limestone is seen with nothing but a black streak of shale above it to represent the coal.

Descending a ravine to Gourd-head run, we get 153 feet of rocks, mostly on the land of Mr. J. A. Herron. (Fig. 125.)

1. Massive Sandstone, Buffalo, seen,	20′
2. Shales,	8′
3. *Limestone*, Brush Creek,	2′

4. Sandy Shales,	7'
5 *Coal*, Brush Creek,	0' 4''
6. Sandstone,	28'
7. Fire Clay and Argillaceous Shales,	35'
8. *Limestone* (Local),	5'
9. Sandstone and Shales,	10'
10. Fire Clay, with Blossom of Upper Freeport Coal at top,	8'
11. *Limestone*, Freeport,	8'
12. Concealed,	35'
13. Coal in bed of Gourd-head run,	2'

This is a very interesting and somewhat unintelligible section.

The Brush Creek Limestone is seen in a ravine, where it forms a water-fall, and huge tables of it, 10 feet square, have broken off, and lie in the ravine below It is fossiliferous, sandy, and of a dark color.

Gourd-head run clay —No 7 is a huge bed of Fire Clay. The upper portion of it is plastic, while the lower is non-plastic. Mr. Herron, on whose land it occurs, has had brick tested from it, and they stand the fire remarkably well, while some portions of the non-plastic clay are suited for glass pots, and have been tested for that purpose in Pittsburg.

Local Limestone.—No 8 is a deposit never seen before at this horizon, as its place is above the Upper Freeport coal, since, a short distance above here, the coal is seen between the two Limestones, 3 feet thick This limestone is a light dove color, is very compact, and occurs in two or three layers. Its upper part is quite ferruginous, and, at some places, is a tolerably rich iron ore.

The Freeport Limestone is No. 11; and the U F. coal which should come above it, is represented by only a small streak of coaly shale, though above here, one fourth of a mile, the coal comes in 3 feet thick at this horizon The upper part of the Limestone is very ferruginous, and much of it could be used as a low-grade ore.

The coal, No 3, is probably the Lower Freeport, though it may be only a local deposit, as this interval is much smaller than I have ever seen it between the two coals The coal has been mined and also stripped out of the creek on the land of Mrs. Meyers. It is reported to be 2 feet thick and tolerably good. The coal is exposed for only a few rods as the *Fifth Axis crosses Gourd-head at this point*, and the coal passes under the stream, both above and below in a very short distance

The same Brady's Bend or Fifth Axis crosses Pine creek at the big bend in the stream below school-house No. 4.

Passing up on the high ground between Gourd-head and Pine creek, we get the following section of 321′ in descending to Pine creek on the land of Mr. J A Herron: (Fig. 126)

1 Concealed from the top of the knob,	50′
2. *Limestone*, Crinoidal,	2′ 6″
3. *Coal*,	0′ 6″
4. Red and Variegated Shales, containing much Iron Ore,	25′
5. Concealed,	50′
6. *Smut of Coal*, Bakerstown.	
7. Concealed,	50′
8. *Dark Fossiliferous Limestone, Pine Creek*,	2′
9. Concealed,	95′
10. *Limestone*, Brush Creek,	1′ 6″
11. Shales and Sandstone,	25′
12. Thin streak of Coal.	
13. Fire Clay, seen,	15′
14. Concealed to level of Pine Creek,	25′

The Upper Freeport coal, or rather its horizon, is 10 to 15 feet below the level of the creek at this locality.

The Crinoidal Limestone is somewhat earthy and impure. It still retains its greenish cast, however, and its multitude of crinoidal fragments and other characteristic fossils.

Mr Herron has dug into the Shales below the limestone in search of *iron ore* of which he found a considerable quantity coming in about the middle of the variegated shale, in various sized nodules, and occasionally in a regular stratum. It contains about 35 per cent. of metallic iron, and did it not cost too much for stripping could be used very well with the richer Lake ores.

No 6 comes at the horizon of the Bakerstown coal, but is only a foot thick.

No. 8 was named, from this locality, the Pine Creek Limestone It is a dark arenaceous limestone, and is very fossiliferous. Its place is immediately on the top of the *Buffalo Sandstone*, which occupies the entire concealed interval, No. 9, at this locality, but which, one half mile below, is seen forming a perpendicular cliff along the stream, 90 feet high.

No. 10, the Brush Creek Limestone, resembles No. 8 very much in its lithology, and it is also fossiliferous. It comes here immediately on top of the Mahoning Sandstone, which is massive only at the top.

No 13 is the upper part of the large bed of Fire Clay which was seen in the section on Gourd-head run. (p. 156.)

One half mile below this we see the following in descending a ravine on the opposite side of Pine creek; the section holds 184 feet of rocks: (Fig. 127.)

1. *Limestone, Pine Creek,* .	2' 6''
2. Concealed, .	90'
3 *Limestone,* Brush Creek,	1'
4 Sandstone, . .	20'
5. *Coal,* .	0' 4''
6. Fire Clay, seen, .	15'
7. Concealed and Sandy Shales, .	20'
8. *Limestone,* Gourd-head, .	2'
9. Fire Clay and Sandy Shales, . .	15'
10 Fire Clay, with Smut of Upper Freeport Coal at top, .	5'
11. *Limestone,* Freeport,	5'
12. Iron Ore and Fire Clay, .	4'
13. Sandstone to level of Pine Creek,	5'

Here we find the *Gourd-head Limestone* only two feet thick, and evidently thinning away as it is quite earthy.

The only representation of the Upper Freeport is a few streaks of coal at the top of the fire clay over the Freeport Limestone.

A bed of iron ore scattered in layers and huge nuggets through the fire-clay occurs under the Freeport Limestone.

On the opposite side of the creek the Buffalo Sandstone is seen occupying interval No. 2 in a massive perpendicular cliff.

Just below here the Fifth or Brady's Bend Anticlinal Axis crosses the stream, and the rocks dip rapidly down to the north-west.

At the mouth of Crouse's run, the Brush Creek Limestone is only 40 feet above Pine creek

Continuing on up that stream, we find the rocks still dipping down until at the mouth of Montour's run the Pine Creek Limestone is only 15 feet above the level of the water.

Where the road crosses Pine creek above this, near the western line of the township, we find the same limestone at the road side ten feet above the creek. It is very compact and of a grayish white color.

22. Richland Township, Allegheny County.

This lies directly north from Hampton, and east from West Deer, and adjoins the Butler county line.

No large streams cut down into the rocks in this township, but it is a common heading ground for several streams

Deer creek heads on its eastern slope; several tributaries of Pine creek rise in it and flow south, while on its northern slope the waters of Glade creek and Breakneck take their rise and pass north into the Connoquenessing.

We thus get very high land in the township, and the Upper Freeport coal is 100 feet below the surface at the nearest point The township is consequently occupied exclusively by the Barren Measures, which extend up above the Morgantown Sandstone, at many localities in the northern part

On the West branch of Deer creek, the Brush Creek Limestone is seen along the road one foot thick, one mile above the mouth of that stream, and just in the edge of the township. It is dark colored and fossiliferous, and comes ten feet above a very hard silicious sandstone.

Continuing up this stream, we come to the Butler plank road, one mile south from Bakerstown, and there a coal was once mined at the road side on the land of Mr. Dunbar The opening is now fallen in, but Mr Dunbar informed me that the coal was good, being 2½ feet thick and having ten inches of cannel coal at the bottom of the bed.

Type locality of the Bakerstown Coal bed:—

Passing over to Bakerstown, we find the same coal has there been mined on the outskirts of the village for a great many years by Mr Flick, and from this locality it has been termed the Bakerstown coal. A large amount of coal has been taken out here, but the mine has been abandoned on account of the difficulty in draining it.

The coal is said to be 2 feet thick, besides 11 inches of cannel coal at the bottom

One half mile south from Bakerstown, Mr. Douglass is opening a bank in this coal, and there we see the following: (Fig. 128.)

1. Crinoidal Limestone,			2′
2. Concealed, .			90′
3. Coal, Bakerstown,	1. Coal,	1′ 6″	2′ 8″
	2. Slate,	0′ ¼″	
	3. Coal,	0′ 4″	
	4. Slate,	0′ ½″	
	5. Coal,	0′ 3″	
	6 Slate,	0′ ½′	
	7 Cannel,	0′ 6″	
4. Fire Clay and Sandy Shales, seen,			6′

The coal is quite slaty at the out-crop, as the section will show, but Mr. Douglass tells me it gets to be solid coal, when followed into the hill.

The cannel at the bottom is extremely variable, both in thickness and quality, sometimes running up to a foot, and again almost running down to nothing. It is generally impure, but sometimes becomes better, and is then burned along with the rest of the coal.

The Crinoidal Limestone is seen in the field above the coal, its greenish rough blocks lying scattered around over the hill, and crowded with organic remains.

Passing west from Bakerstown along the Beaver road, we see nothing but Sandstone and Shales with an occasional band of red clay.

23. *Reserve Township, Allegheny County.*
McClure Township, Allegheny County.

These are two small areas, which adjoin each other, and encircle Allegheny city on the north.

Spring Garden and Butcher runs pass through Reserve They both have a very rapid fall throughout their course.

Wood's run passes through the center of McClure, and enters the Ohio below Brunot's Island.

Along the Allegheny river between the mouth of Girtie's run, and the mouth of Wood's run the *Crinoidal Limestone* is almost constantly in sight, and with it we see another one associated, as in the following section, which is seen one mile below the mouth of Girtie's run: (Fig. 129.)

1. Coal and Bituminous Shale, Elk Lick, ...	2′
2. Fire Clay, . .	1′
3. *Limestone*, ...	0′ to 5′
4. Sandy Shales, .	35′
5. *Limestone*, Crinoidal, . .	2′
6. *Coal*, .	0′ to 1′
7. Variegated Shales to level of West Penn. R. R., .	15′

The *Elk Lick coal* is sometimes an impure bituminous coal, and at others a very impure cannel, or bituminous slate The limestone below it is seen all along the West Penn railroad, in the cuttings between the mouth of Girtie's and Butcher's runs. It is a black calcareous mass, containing many fossils, and very irregular in its thickness, at times suddenly running up to 5 and 6 feet, and as rapidly thinning away entirely.

This *Elk Lick limestone* has possibly been taken sometimes for the Crinoidal along the Monongahela river opposite Pittsburg, as the latter is here the same greenish, compact rock we nearly always see it, while the former resembles very much the stratum seen on the south side of the Monongahela. These two Limestones are seen along Spring Garden and Butcher runs throughout their course in Reserve township

The *Pittsburg coal* comes into the summits of the hills in the northern part of the township, and descending from it to Spring Garden run we get the following 320 feet: (Fig. 130)

1. Pittsburg Coal, . . .	?
2. Concealed, .	80 ′
3. *Limestone*, .	3 ′
4. Red Shales, Argillaceous, .	20 ′
5. Sandy Shales,	50 ′
6. Massive Sandstone, Morgantown,	50 ′
7. *Coal*,	0″—12″
8 Variegated Shales, . .	50 ′
9. *Coal*, impure Cannel, Elk Lick, . .	1′ to 1½′
10. Shales, .	3 ′
11. *Limestone*, ...	2′ to 3 ′
12. Shales and Sandstone, .	35 ′
13. *Crinoidal* Limestone,	2′ to 3 ′
14. *Coal*, . .	1 ′
15. Variegated Shales to level of the run,	20 ′

The *Morgantown Sandstone* is very massive, and has been extensively quarried for building purposes, for which it is well adapted, being a free splitting, grayish-white rock, which dresses easily, and withstands the weather without crumbling. This is the rock which is quarried far up in the hills, back from Allegheny City.

The Elk Lick coal is an impure cannel, and has been stripped out of the run at one point, just before we enter Ross township

Going north-west up these streams, the strata rise 100 feet per mile on the eastern slope of the Fifth or Brady's Bend Axis. From Allegheny City west, the strata rise very rapidly, and, at the mouth of Wood's run, we come to the crest of the Fifth Axis, which crosses at this point, and throws the Crinoidal Limestone 200 feet above the level of the Ohio.

Here at the mouth of Wood's run, we see the following in descending the newly-graded road to the Ohio river 206′: (Fig. 131.)

1. *Limestone*, Crinoidal,	2′
2. Red and Variegated Shales,	30′
3. Sandy Shales, with massive Sandstone at bottom,	80′
4. *Limestone*, "Pine Creek,"	2′
5. Variegated Shales,	10′
6. Massive Sandstone, Buffalo,	50′
7. Dark Sandy Shales,	7′
8. *Coal*, "Brush Creek,"	2″ to 4″
9. Dark Shale.	
10. Concealed to the Ohio river,	25′

No. 6 is the massive Sandstone which is seen all along the railroad from Wood's run to Haysville.

Occasionally Nos. 4 and 5 of the section are cut out, and we get a solid mass of Sandstone 100 feet thick, as the lower 40 feet of No. 3 is massive. No. 7 contains some small quartz pebbles near its base.

The Lower Freeport coal should be found here at a depth of 80 to 100 feet below the Ohio, while at Pittsburg, 3 miles above, it is at least 250 feet below the same, so that, should search ever be made for that coal in the vicinity of Pittsburg, it should be done at Wood's run The Pine creek Limestone is seen a short distance up the run, but as we trace it around the point, it is cut out entirely by the coalescence of Nos. 2 and 5. Where seen, it is quite ferruginous, and fossiliferous.

24. Ross Township, Allegheny County.

This lies north from McClure and Reserve and west from Shaler. Its streams are all small, and it contains some very high land, which takes in small patches of the Pittsburgh coal in the southern part.

Girtie's run, with its several small tributaries, flows through its north-eastern part, while Spring Garden, Butcher's, Wood's, and Jack's rise on its southern slope.

The Pittsburg coal is found in the high knobs, between Spring Garden and Butcher's runs, and is now mined in one of them by Mr. Williams, and at his bank the following is seen to be the section of the bed: (Fig. 132.)

1 Coal, somewhat slaty,	2' 4"	4' 8"	9' 10"
2. Shale,	6"		
3. Coal,	1' 2"		
4. Shale,	8"		
5. Coal,	3' 6"	5' 2"	
7 "Bearing-in Coal," with thin Slates above and below,	4"		
8. Coal, "bottom,"	1' 4"		

This coal is quite good, except near the surface, where, of course, it has deteriorated by oxidation. It is nearly all mined out.

Just north of this is another outlier of the Pittsburg coal in the top of a knob, owned by Miss Neely and Mr. Layng.

At the head of Spring Garden run there are two outlying patches of Pittsburg coal on the land of Mr. Ramsey ; each one contains two or three acres, and the coal is nearly all taken out of both

At the head of Wood's run there are two more small areas of the Pittsburg coal, caught on the land of Mr. Goff, and one half mile north from this, and just east from the Perrysville plank road, there is another small area on the land of Mrs. Rhodenbaugh, which contains only about one acre, and there is very little coal left in this knob These last three small areas are just on the crest of the Fifth Axis, and the coal is 600 feet above the Ohio river.

Descending from the coal at Mrs. Rhodenbaugh's to the forks of Girtie's run, above Ever Green, we go over the following intervals through a section of 423½ feet: (Fig 133.)

1. Pittsburg Coal,	10 '
2. Concealed,	280 '
3. Crinoidal Limestone,	2 '
4 Shales, and concealed,	100 '
5. Massive Sandstone,	15 '
6 Limestone, Pine Creek,	½'
7. Dark Sandy Shales, seen,	6 '
8. Concealed to level of run,	10 '

Here, near the Forks of Girtie's run above Ever Green, the Fifth Axis crosses and the dip is changed as we ascend the stream. Descending Girtie's run past Ever Green, the *Pine Creek Limestone* is occasionally seen along the stream, dipping very rapidly to the south-east.

The sandstone above it is very massive, and sometimes forms perpendicular cliffs 30 to 40 feet high.

Passing up either branch of Girtie's run, toward Perrysville, the *Crinoidal Limestone* is frequently seen cropping out along the sides of the hills, and at Perrysville we come to the limestone which is often found 80 or 90 feet below the Pittsburg coal.

In going down Jack's run from its head, we pass successively over the Crinoidal and Pine Creek Limestones, and at the mouth of the stream come down to the *Brush Creek Limestone*, which is there seen a few feet above the Ohio, and immediately under the Buffalo Sandstone.

25. McCandless Township, Allegheny County.

This lies immediately north from Ross, and west from Hampton. Pine creek flows west nearly through its center, and receives numerous tributaries from the north, while Girtie and Lowrie's runs head up in its southern part

This township lies in the trough west from the Fifth Axis, and the lowest rock exposed in it is the Pine creek Limestone, which is seen in the bed of Pine creek, just as it leaves the township. The Pittsburg coal is caught in a single knob, at the western line of the township.

The Barren Measures cover all the rest of the township. and the least depth to the Upper Freeport coal is 180 feet.

A short distance above the mouth of Montour's run, the *Pine Creek Limestone* is seen where the road crosses Pine creek. It is 5 feet above the level of the stream, and is light-colored, very compact, and contains many fossil shells and Crinoids. Just below this, we see a massive sandstone above the Pine creek Limestone, and immediately under it is a coal, or black shale, which has been opened at this point. It comes about 30 feet above the Pine Creek Limestone, and may be the Bakerstown coal.

Below the mouth of Montour's run, a very massive sandstone begins to rise out of the stream This is the *Buffalo Sandstone*, which attains such an enormous development a few miles below, in Hampton township

Passing up the main branch of Pine creek, we see the following, near the old Buckeye hotel 146 feet:— (Fig 134.)

1 Black Bituminous Slate (Elk Lick Coal), .	1′ 6″
2 Fire Clay and Shales,	4′ 0″
3. *Limestone*, . (*Elk Lick Limestone*),	1′
4. Concealed,	35′
5. *Limestone, Crinoidal*,	4′
6. *Coal*,	1′ 6″
7. Concealed,	75′
8. *Coal, Bakerstown*,	3′ to 4′
9. Concealed to creek,	20′

Here we catch another glimpse of the limestone seen underlying the Elk Lick coal, at Allegheny City. Only the top of it is seen It is a dark gray rock, and tolerably compact The Crinoidal is in three layers, separated by shales

The little coal under it has there been stripped out on the land of Mr. Moon, who reports it quite pure, 1½ feet thick.

The Bakerstown coal was once mined, but was difficult to drain, and had to be abandoned. Mr. Moon says it ran from 3 to 4 feet in thickness, and had one foot of cannel coal at top. The roof is bad, and was continually falling in. The coal burned very well, though it made a large amount of ash.

Near the head of Pine creek, a high knob catches a small area of the Pittsburg coal, and, descending the hill to Pine creek, we see the following 385 feet of rocks: (Fig. 135.)

1. Concealed from the top of the knob,				40'
2. Coal, Pittsburg,	1. Roof coal in several layers,		4'	10' 8"
	2 Shale,		1' 2"	
	3. Coal, "Main Bench,"		3' 4"	
	4. "Bearing-in Coal,"	1 Slate, ¼' 2 Coal, 4½" 3. Slate, ¼"	5"	
	5 "Bottom Coal,		1' 9"	
3. Concealed, .				290'
4 *Limestone*, Crinoidal,				4
5. Concealed to Pine Creek,				40'

The surface of the ground above the coal is strewn with huge blocks of the *Pittsburg Sandstone.* None of it is seen as the bed, however. The coal is mined in this township by Mr Sarver and Mr Neely. The floor of the coal is 1,325 feet above tide, approximately, as I was enabled to check my barometrical base only a short distance away, where the projected Pittsburg and North-West railroad crosses Pine creek, on the Alston farm. The coal is nearly all taken out of the hill, and is much inferior to the usual quality of Pittsburg coal, on the Monongahela, though its inferiority is due entirely to its long exposure so near the surface

The Crinoidal Limestone is seen along the creek road well exposed, where it is seen to consist of three layers of rock, separated by calcareous shales It is hardly as compact as when single, yet it retains its greenish color, and multitudes of Crinoids.

On Pierce's branch of Pine creek, one mile below Pierce's mill, we see the following, on the land of Mr. Warner: (Fig. 136.)

1. *Crinoidal* Limestone,	3'
2. Concealed,	80'
3. *Coal*, Bakerstown,	0' to 2½'
4. Concealed to creek,	35'

Here an opening has been made in the Bakerstown coal by Mr Warner. At the mouth of the drift there is 2 to 2½ feet of impure coal, with 6 inches of cannel at the bottom; but, on following it into the hill, the coal all disappears in a few rods, and is replaced by a dark, sandy, bituminous shale. Just below Pierce's mill, the Crinoidal Limestone is seen above the road with its immense band of red clay coming in below. The Limestone is 80 feet above the creek.

26. *Pine Township, Allegheny County.*

This lies immediately north from McCandless, and adjoins the Butler county line.

It is drained by Pine creek on the south, Brush creek on the west, and Breakneck on the north. It therefore contains about the highest land in the county.

The Pittsburg coal is caught in a solitary knob in its southern part, and, with this exception, the whole surface is covered by the Barren Measures, the Upper Freeport coal being at no point less than 200 feet below the surface.

As previously stated, the Pittsburg coal is caught in a high knob, which rises above all its neighbors by about 100 feet, just east from Pierce's branch of Pine creek and one mile north from the southern line of the township. This is its most northern point within our district.

Here, on the land of Mr. Emmit, we get the following section of 362½ feet in descending to Pine creek: (Fig 137.)

1. Concealed from top of knob,				25'
2. Pittsburg Coal,	1 Slaty Coal,	1' 0"	3' 3"	9'
	2. Shale,	0' 4"		
	3 Coal,	1' 2"		
	4 Slate,	½"		
	5. Coal,	9"		
	6. Shale,		1' to 1½'	
	7. Coal,	8"	5'	
	8. Slate,	1"		
	9. Coal,	2' 4"		
	10. Slate,	½"		
	11. Coal,	4"		
	12. Slate,	½"		
	13. Coal,	9"		
	14. Slate,	¼"		
	15. Coal,	1' 4"		
3. Concealed,				90'
4. *Limestone,*				4'
5. Red Clay,				20'
6. Concealed,				135'
7. *Coal,* Elk Lick,				½ to 2'
8. Shales, and concealed,				35'
9. *Limestone,* Crinoidal,				2½'
10. Red Clay,				25'
11. Concealed to level of the creek,				15'

Here the Pittsburg coal has been mined for forty years on the land of Mr. Emmit, where about 2½ acres of it are caught in the knob. It is nearly all worked out now The coal being exposed so near the surface is, of course, very much deteriorated, and the main body shows more partings of slate than usual.

The floor of the coal is 1,360 feet above tide as determined by connecting it with a point on the projected Pittsburg and North-Western railroad, two and a half miles distant, which makes the coal at this point about 325 feet higher than at Pittsburg.

No 4 is a very light-colored limestone, quite compact, and breaks with conchoidal fracture Both it and the red clay below seem to be persistent, as they are seen at every point in the country where their horizon is exposed.

The clay is a dull red, with a streak of light yellowish marl near its middle, which gives to the mass a kind of mottled appearance

The Elk Lick coal was once opened by Mr. Emmitt, and, at the mouth of the bank, was two feet thick, and a tolerably fair coal, but, on drifting into the hill, it thinned away to only six inches.

The Crinoidal Limestone is seen with its typical character, being a dark greenish, compact rock, filled with fossils, of which the most abundant are crinoids.

Near Wexford Post Office the limestone coming 90 feet below the Pittsburg coal is seen about 40 feet below the summit of the hill

At the head of Brush creek the Crinoidal Limestone is seen on the land of Mr. Graham, and the blossom of the Bakerstown coal is seen 75 feet below it.

27. *Marshall Township, Allegheny County.*

This is the north-western township of the county, lying directly west from Pine, and being bounded on the north by Butler county and on the west by Beaver

It is drained by Big Sewickley* creek, which heads up in its center, and flows out of it to the south. Brush creek flows in a sluggish stream across its north-eastern corner.

---

*There is another Sewickley creek in Westmoreland county.

There is very little of interest in this township, as it is covered entirely by the Barren Measure Shales, and few exposures occur.

On the branch of Big Sewickley, which flows along near the Beaver county line, the Brush creek coal and its overlying limestone are seen. The coal was once mined on the land of Mr. Cull, and the *Brush Creek Limestone* is seen 1½ feet thick, and 10 feet above the coal Nothing could be learned concerning the latter. The limestone goes under the stream between the two saw-mills, and then passing up on the elevated land, we see the *Crinoidal Limestone* with its underlying red clay near school-house No. 4 Passing down on to the head of another branch of Big Sewickley, we see the *Pine Creek Limestone* near the house of Mr. Bower, where it occurs in the bed of the creek, one foot thick, while the Crinoidal is seen in the hillside 120 feet above.

Along Brush creek we find a broad and level valley excavated out of the Barren Measure Shales, and there everything is concealed so deeply by debris that scarcely a rock can be seen in place.

The Upper Freeport coal is, however, about 100 feet below its surface, where Brush creek passes into Butler county.

28. *Franklin Township, Allegheny County.*

This is a triangular area, which lies immediately south from Marshall, of which it was formerly a part.

No large streams pass through it, but Big Sewickley flows along its western border, while Little Sewickley, Killbuck, and Lowrie's runs rise on its southern slope and flow south to the Ohio. We find some very elevated land in this township, and the Pittsburg coal is caught in three small isolated areas; with these exceptions the Lower Barrens cover all the rest of the township, and the least depth to the Upper Freeport coal is not far from 100 feet.

Duff's run puts into Big Sewickley near the north-western part of the township, and on this stream, one mile above the stone mill, the Elk Lick coal is mined on the land of Mr. Aiken, where we get the following succession 139′: (Fig. 138)

1. Dark Shales,		10′
2. *Coal*, Elk Lick,	1. Cannel, impure, 8″ 2 Coal, 2′ 0″	2′ 8″
3. Concealed,		25′
4. Limestone, Crinoidal,		1′ 6″
5. Concealed to Duff's run,		100′

This coal which the section shows to be *Elk Lick* has been mined quite extensively, as it is the only coal accessible for several miles It is a bright, lustrous coal, quite rich in bitumen, and containing very little visible pyrites. The *cannel* at the top is generally too impure to burn, but sometimes it can be used

The Crinoidal Limestone has been burned on the land of Mr. Aiken It is a mere mass of fossils The clays under it are very marly, and many land slides have occurred.

Passing up from this limestone we come to a very high knob on the land of Mr Schuring, and there about 20 feet below its summit occurs the *Pittsburg coal* 300 feet above where the Crinoidal Limestone was last seen, ¾ of a mile to the west. This is near the center of the southern line of Franklin township, and is *the most western outcrop of the Pittsburg coal in the district.*

There is only about one acre of coal in this area. The coal was once mined here, but has been nearly all taken out, and the opening is now fallen in and abandoned, so that the structure of the coal could not be seen. Mr. Schuring, however, informed me that only the main bench was mined, 6 feet thick, while the roof coal was 4 to 5 feet more.

Two miles south-east from this we find another small area of this coal in the summit of a high knob on the land of Mr. Wright, and there we see the following: (Fig 139.)

1. Concealed from the top of the hill,				30′
2. Sandy Shales,				3′
3. Coal, Pittsburg,	1. Roof Division,	1. Coal, 2′ 6″ 2. Shale, 1′ 6″ 3. Coal, 2′ 6″	6′ 0″	12′
	2. Shale,		1′ 2″	
	3. Main Bench,	1. Coal, 2′ 9″ 2. Slate, ⅛″ 3. Coal, 4″ 4. Slate, ½″ 5. Coal, 1′ 8″	4′ 9″	

This coal has been mined for a great many years to supply the country around, but is now about worked out. There were originally 5 acres of it in the hill. The roof coal is never taken out. It shows an immense development, and is somewhat slaty.

The concealed portion above the coal is covered with immense blocks of massive Sandstone, which are fragments of the *Pittsburg Sandstone.*

From the summit of this knob, we have a magnificent view of the surrounding country, and can see nearly all the Pittsburg coal hills in the county; Schuring's to the west, Sarver's to the north, and away further to the north Mr. Emmitt's in Pine township

About midway along the eastern line of this township, we come to another knob containing the Pittsburg coal in its summit, part in Franklin and a portion in McCandless township. Mr Vandever mines the coal in Franklin township, where there is five feet of coal taken out, and as much more left in the roof. There are about 4 acres of this coal area in both townships. Passing down to Pine creek we go over the outcrop of the *Morgantown Sandstone*, which is quite massive, and come down to the Elk Lick coal, 250 feet below the Pittsburg. It was once mined several years ago on the land of Mr. Brown, but the opening has long since fallen in, and the coal cannot be seen. I was informed, however, that it was 2 feet thick.

29. Ohio Township, Allegheny County.

This lies south from Franklin and west from Ross, having the Ohio river for its southern boundary.

All its streams flow south into that river, among the principal of which are Killbuck and Lowry's runs.

The township is occupied entirely by the Barren Measure series, since none of the streams cut down to the Upper Freeport, and the Pittsburg coal is not caught in any of the hills. The *Upper Freeport coal* lies about 75 feet below the Ohio at its eastern border, and 35 to 40 at its western.

In its south-eastern part, a beautiful *terrace* is seen 280 feet above the Ohio, and Bellevue is built on it. It contains all kinds of metamorphic gravels and boulders, the most of which are small, and passing down from this, we come to another at Balie's Tavern ; this is a very fine one, and is 120 feet above the Ohio. It is continuous along the river for a long distance

At the mouth of Spring House run, which puts into the Ohio, a short distance above Lowrie's run, the *Brush Creek Limestone* is seen near the level of the railroad track, where it is ten inches thick, and the massive Buffalo Sandstone rises in a perpendicular cliff above it, and below the Limestone is seen the top of a very massive Sandstone, which is the Mahoning.

At the mouth of Lowrie's run, the *Buffalo Sandstone* is seen in cliffs along the railroad with its base near the level of the track, and passing up this stream the rock rises quite rapidly, frequently forming perpendicular cliffs along its sides. It is here no longer a conglomerate, but a tolerably coarse-grained homogeneous sandstone

Near the head of the stream, the hills rise very high, and one, near the Franklin township line, catches the blossom of the *Pittsburg coal*, on its very summit

On the left branch of this stream, the Crinoidal Limestone is seen 110 feet above it, on the land of Mr. Thompson, where it has been quarried and burned and he reports that it makes excellent lime It is 2 feet thick, and is the same greenish fossiliferous Limestone, which we always see it.

On the highlands between the head-waters of Lowrie's and Killbuck runs, we come to the limestone and red clay which underlie the Pittsburg coal at an interval of 90 feet. They are seen along the road for some distance. The hills rise above the Limestone only 50 feet, and are consequently too low to take in the Pittsburg coal

Going down to the head of Killbuck run, we find the Crinoidal Limestone exposed at the road-side, near the school-house, and 45 feet above the run. Descending Killbuck run, it falls very rapidly, and soon cuts down into the

Buffalo Sandstone, and a short distance below Duff's Mills we see the following section of 170 feet: (Fig. 140.)

1. Crinoidal Limestone,	?
2. Concealed,	110′
3. Massive Sandstone, Buffalo, to level of run,	60′

Here a row of limestone boulders were seen at the horizon, which I have assigned to the Crinoidal, though it is very probable that they belong a few feet higher.

The *Buffalo Sandstone* is quite massive, and rises in wall-like cliffs along the stream from this point for a long distance below. Occasionally its base comes above water level, and then we see the *Brush Creek Limestone* below it One mile above the mouth of Killbuck, we see the following, 286 feet of rocks, descending a steep hill: (Fig. 141.)

1. Massive Sandstone, Morgantown, seen,	20′
2. Concealed,	65′
3. *Limestone, Crinoidal,*	2′
4. Red Clay,	30′
5. Concealed,	85′
6. *Pine Creek Limestone,*	2′
7. Massive Sandstone, Buffalo,	75′
8 Shales,	8′
9. *Brush Creek Limestone,*	1′
10. Concealed to level of run,	8′

Here the Morgantown Sandstone is seen in a massive cliff, extending around the top of the knob, while huge masses of it are scattered all over the hillside. It is a grayish-white, and tolerably coarse, compact sandstone.

The Pine creek Limestone is a light dove-colored rock, somewhat brecciated, and fossiliferous. It rests immediately upon the Buffalo Sandstone, which is here seen in a perpendicular cliff.

The Brush creek Limestone is a dark arenaceous rock, and fossiliferous.

At the mouth of Killbuck, the Morgantown Sandstone is seen in a long line of cliffs, near the top of the hill, and the sides of the same are covered with its huge fragments. Below the mouth of Killbuck, the strata commence to rise to the west, and the Buffalo Sandstone thins away, and is no longer seen in massive cliffs along the Ohio hills; but we find a beautiful terrace, whose top is 80 feet above the Ohio, and extends along the river for a long distance.

30. *Sewickley Township, Allegheny County.*

This lies directly west from Ohio township, and adjoins Beaver county.

The Ohio river washes its southern shore, and Big Sewickley creek forms its western boundary, while Little Sewickley flows south through it, almost parallel to the Big creek.

None of the streams, however, cut down into the rocks to the Upper Freeport coal, and hence the Lower Barren Series occupy its entire surface.

The terraces along the Ohio, in this township, are exceedingly beautiful We get one at 30 to 40 feet above the Ohio, another at 80, and still another at 120. The one at 80 feet is the largest and most persistent It forms the delightful plain on which stands the village of Sewickley. It contains a great many rounded metamorphic boulders

Where the Beaver road crosses Little Sewickley creek, the Mahoning Sandstone is seen in a massive stratum near the bridge, and has been quarried extensively. It is a coarse, grayish-white rock, specked with iron stains, and makes an excellent building stone, as it splits easily into most any desired shape, and withstands the action of the elements remarkably well.

The Brush Creek limestone is seen a short distance above the bridge along the road, which passes up Little Sewickley. It is 80 feet above the creek, and is a dark, calcareous, shaly rock, filled with fossils. It is frequenly seen along the stream, as we ascend it, and two miles above its mouth it comes down within 10 feet of the creek, and the Brush creek coal is seen below it, in the following section: (Fig. 142.)

1. Massive Sandstone, Buffalo' seen, ...	40′
2. Shales, ...	5′
3. *Limestone*, Brush Creek, . . .	1′
4. Dark Shales, ...	10′
5. *Coal*, Brush Creek, ...	1′ 6″
6. Concealed to the creek, ...	8′

Here the Brush Creek coal has been stripped out of the creek bank on the land of Mr. McKane It is reported to be quite good, though too thin to pay for drifting

The Limestone above it is very hard and black, and contains many fossils.

The Buffalo Sandstone comes down to the creek just above this, or rather the creek bed comes up to it, for the stream's bed rises faster to the north than the strata.

At the mouth of Big Sewickley, the Mahoning Sandstone is seen in quite a massive cliff, where the Beaver road crosses that stream, and just above it is a quarry on the Allegheny side. The rock is a very fair building stone.

The Upper Freeport coal should there be seen at about the level of the Ohio river, but is, of course, concealed by the terrace deposits, if, indeed, it exists at all, which is quite doubtful, since at no point along the Ohio, between this and the mouth of the Beaver, does it ever attain available thickness. Ascending the Big Sewickley, the rocks rise about as fast as the stream's bed, and the Mahoning Sandstone is seen along the creek for a long distance.

On the steep hill side, near the mouth of Big Sewickley, we see the following: (Fig. 143)

1. *Crinoidal Limestone,*	8′
2 Variegated Shales,	25′
3 Concealed,	100′
4 Shales and Shaly Sandstone, Buffalo,	60′
5 *Limestone, Brush Creek,*.	2′
6 Concealed,	80′
7. Massive Sandstone, Mahoning, seen,	25′
8. Concealed to the level of the Ohio,	10′

The Crinoidal Limestone is very full of fossils, and is scattered in large blocks all over the hill.

The Buffalo Sandstone is a mere mass of sandy shales, which, however, make a steep and almost perpendicular escarpment along the hill, while the Brush Creek Limestone is seen in large square masses below, where it has slid down from its bed.

CHAPTER X.

BEAVER COUNTY.

31. Economy Township.

This lies south from New Sewickley township, and is bounded on the south-east by Allegheny county, and on the west by the Ohio river. No important streams enter the Ohio within the township, but Big Sewickley flows along its south-east border

At the mouth of Big Sewickley the river turns and flows north, and the strata rise quite rapidly, so that at the western line of the township the Kittanning coal makes its appearance above the Ohio, at the mouth of Crow's run. The lower coals are exposed only along the Ohio, and for a short distance back into the country, as the small streams fall so rapidly that the coals are very soon carried under their beds.

Along Big Sewickley, the strata rise as fast as the stream's bed, and consequently the Upper Freeport coal should be found at about 25 to 30 feet below, anywhere between the mouth of the stream and the mouth of McPherson's branch.

Two miles above the mouth of McPherson's branch we see the following in descending a hill on the land of Mr. Hoenick, at the mouth of Fink's run: (Fig. 144.)

1. *Limestone*, Pine Creek,	2' 6''
2. Concealed, and Sandy Shales,	60'
3. *Limestone*, Brush Creek,	1' 8''
4. Sandy Shales,	12'
5. Black Slate, seen,	2'
6. Concealed to the level of the creek,	25'

No. 1 is a dark, grayish stratum somewhat nodular, and containing many fossil shells, crinoids, &c. It is the Pine Creek Limestone.

No. 3 is a very hard, compact, arenaceous limestone, of a pinkish tint on its weathered surface and contains much iron. It is also fossiliferous, holding *Chonetes*, *Productus*, &c. No. 5 probably represents the Brush Creek coal.

Near Wall Rose post office some very high hills rise to within 100 feet of the Pittsburg coal, as they extend 200 feet above the Crinoidal Limestone, and catch the White Limestone on their summits, which comes 90 to 100 feet below that coal

Just north from Wall Rose post office the Crinoidal Limestone is seen above the road in fragments strewn over the ground, while below it comes the great bed of red clay, here 30 feet thick, and making a conspicuous mark in the roads and fields. This limestone is 180 feet above the bed of McPherson's branch. One half mile north-west from the blacksmith's shop, a coal was once opened on the land of Mr Gross in the summit of a high knob It comes 40 feet above the Crinoidal Limestone, and is therefore the Elk Lick coal The bank has long been abandoned, as there was no roof above the coal, and it could not be mined to advantage It is reported to be 3 feet thick. Passing north from this point along the Beaver and Pittsburg road, the Crinoidal Limestone is frequently seen near the summit of the hills, and always accompanied with its underlying red and variegated clay.

Near the northern edge of the township, the following section is seen along the road descending from McDonald's store to Crow's run: (Fig. 145.)

1. *Limestone*, Crinoidal,	1′ 6″
2. Red Clay,	30′
3. Sandy Shales,	90′
4. *Limestone*, Pine Creek,	2′
5. Shales,	10′
6. Somewhat massive Sandstone, Buffalo,	50′
7. Concealed to level of Crow's Run,	120′

No 1 is seen near the top of the hill at the forks of the road, and the red clay below it is a conspicuous landwork in the road for a long distance.

No. 4 is seen in a bed of nodules along the road, and is a light grayish stratum, and also fossiliferous.

The Buffalo Sandstone is quite massive, and forms a cliff along the stream, or rather a steep escarpment.

The Upper Freeport coal must be near the level of the stream, but everything is covered up by debris and nothing can be seen. Near the north-east corner of Economy township, the Brush creek coal is mined on the land of Mr. Bock, and there we see the following: (Fig. 146.)

1. *Limestone*, Brush Creek,	1'
2. Dark Shales,	12'
3. *Coal*, Brush Creek,	3'

The coal is mined to some extent for local supply It is a variable seam, sometimes showing 3 feet of coal, and again running down to 2 and even 1½ feet It is divided near the bottom by a parting of slate, 1 to 3 inches thick. The coal has a dull luster, is somewhat slaty and cannot be used for smithing purposes It burns very well in the grate, however, and is of much value to the immediate neighborhood, which, without it, would be very badly off for coal

The shales over it are a dirty, black crumbling mass, and at times they contain so much bituminous matter as to resemble a *cannel* in appearance.

Returning to the Ohio at the mouth of Big Sewickley we find a very handsome terrace extending along the river up to Economy, where it forms the site of that village, 120 feet above the Ohio. Everything along the river front, in the vicinity of Economy, is covered up by the terraces, but on the opposite side of the river the following section is seen, which will answer for the Economy side of the river as well: (Fig. 147.)

1. *Limestone*, Crinoidal,	4'
2. Red Shales,	25'
3. Concealed,	100'
4. Finely laminated Sandstone, Buffalo,	70'
5. Brush Creek Limestone,	4'
6. Dark Shales,	12'
7. *Coal*, Brush Creek,	1' 8''
8. Sandstone, Mahoning, seen,	85'
9. Concealed to level of the Ohio,	100'

The horizon of the Upper Freeport coal would be about 50 feet above the Ohio, though there is doubtless no workable coal here.

The Brush Creek Limestone is a black mass of calcareous shale, and is filled with fossils; the Brush creek coal is a semi-cannel. The smut of this coal is seen along the road just north-east from Economy, and also the limestone above it.

On Legionville run, the Mahoning Sandstone is quarried one half mile above its mouth on the Harmony tract. It is quite a massive rock, and makes an excellent building stone, being very compact, grayish-white, and much specked with oxide of iron.

At Baden Station, the Lower Freeport coal is brought up to the railroad level, and has there been mined near the station on the land of Mr Berry. Here we see the following. (Fig. 148.)

1. Shales, Sandy,	10 '
2. *Coal*, Lower Freeport,	1½'— 2 '
3. Fire Clay,	1½'
4. Limestone, Butler,	2 '
5. Concealed to the level of the Ohio,	45 '

The coal was once mined at this locality, but was only 1½ feet thick, and impure at that. The limestone under it, is seen very finely exposed along the little run which puts into the Ohio, at the upper end of Baden. It is a very hard compact rock, breaking with sharp angular fracture, is a light gray, in color, and much brecciated. It also contains small iron nodules. It was once burned by Mr. Berry, but did not slack well.

The *Butler limestone* is also seen along the road, opposite the steam mill in Baden.

Tivebaugh run comes into the Ohio just below Baden station, and here the Lower Freeport is mined, a short distance above its mouth, by Mr Lee. The coal is 2½ feet thick, and has a small streak of slate 6 inches below its top. It is a tolerably good coal, though containing rather too much slate. It has a bright shining luster, and comes out in handsome blocks.

Just above this a short distance, and on the opposite side of the run, the same coal is mined by Mr. Larkin, and there we see the following 22½': (Fig. 149.)

1. Shaly Sandstone,	5'
2. Shales,	5'
3. Coal,	2' 6''
4. Concealed to Tivebaugh,	10'

No partings are seen in the coal, though it contains too much sulphur for smith's use.

Passing up Tivebaugh, the Lower Freeport coal soon runs under, and the bed of the stream, rising quite rapidly, comes up to the Freeport Limestone a short distance above the mouth of Davis's run. Here descending from the hill road we get the following section 279′: (Fig 150)

1. *Limestone*, Crinoidal,			2′
2. Red Clay,			80′
3 Concealed, .			70′
4. Sandy Shales,			60′
5. *Limestone*, Brush Creek,			1′
6. Concealed			20′
7. *Coal*, Brush Creek,. .	1. Coal,	12″	3′
	2 Shale,	9″	
	3. Coal,	15″	
8. Sandy Shales, and thinly bedded Sandstone, Mahoning,			85′
9. Fire Clay,			5′
10. Limestone, Freeport, .			3′

The Crinoidal Limestone is seen on the hill near Mr. Corkon's, along the road, and the red clay is a marked feature below it. The Brush Creek Limestone is here separated from the underlying coal by an interval of 20 feet, which is much larger than customary, the usual interval being only 10 to 12 feet.

The limestone itself is a very hard, compact stratum, and contains much iron, in fact almost enough to constitute it an *ore*. The coal below it has been mined by Mr. Davis, but is not now in operation. It is separated into two benches by a parting of slate and shale, which varies from 6 to 18 inches at the expense of the coal The lower bench is best, so Mr. Davis informs me, the upper being somewhat slaty.

The Mahoning Sandstone is a mere mass of sandy shales, with an occasional thin sandstone running through it The Upper Freeport coal should come immediately above the Fire Clay No. 9, but it is here entirely absent, being represented by nothing but a black slate one half foot thick at the top of the Fire Clay.

The Fire Clay is very pure, and would doubtless make excellent fire brick. The Freeport Limestone below it is seen in two layers, the top one being one foot thick and having a slaty fracture, while the lower is quite compact, and light gray in color. It is seen in the bed of the stream, a short distance above the mouth of Davis' Branch of Tivebaugh run

At Remmington Station, the Darlington coal is seen at the road-side 12 feet above the track, coming immediately under the Freeport Sandstone, and being 1½ feet thick. It has been stripped near Mr Musgrave's, and is a tolerably good coal.

Passing north along the railroad from this point, we see the strata rising quite rapidly, and, at the mouth of Crow's run, the Kittanning coal comes up to the level of the railroad track, and descending the steep hill, we see the following section of 227′: (Fig. 151.)

1. Mahoning Sandstone, massive, seen,	30′
2 Concealed,	115′
3. Massive Sandstone, Freeport, seen,	20′
4. *Coal, Darlington,* (Upper Kittanning)	Blossom
5 Concealed,	20′
6 Shales, dark at bottom, and containing Iron Ore,	25′
7. *Coal, Kittanning,*	2′
8 Fire Clay,	8′
9. Sandstone to bed of Crow's Run,	2′

Here the Mahoning Sandstone has been extensively quarried on the land of Mr. Conway It is a very massive rock, quite coarse, and even conglomeratic in some portions, and is a fine building stone.

Only the lower part of the Freeport sandstone is seen, but it is very massive, and immediately under it comes the blossom of the Darlington coal

The shales, separating the Darlington and Kittanning coals, are dark in the lower part, and are filled with kidney *iron ore* as usual.

The Kittanning coal has been opened on the land of Mr. Conway. It is 2 feet thick, but rather poor in quality, as it contains much pyritous slate. It was once mined for local use, but has now been abandoned. The large bed of Fire Clay below it is very pure looking.

The Kittanning coal, being only 10 feet above the bed of Crow's run, passes under that stream a few rods above, and a very short distance up the stream we come to an opening in the Darlington coal, on the land of Mr. Conway, near the northern boundary of the township, and there we see the following 76′: (Fig. 152)

1. Massive Sandstone, Freeport,	40′
2. *Coal*, Darlington,	1′ 4″
3. Concealed to level of Crow's Run,	35′

The Freeport Sandstone is seen extending along the creek bank, in a massive perpendicular cliff. It rests immediately upon the Darlington coal, which shows a thickness of only 16 inches at the mouth of the drift, but thickens up to 18 inches further in the hill. It contains more slate than usual for this coal.

32. New Sewickley Township, Beaver County.

This lies directly north from Economy, and adjoins the Butler county line.

Brush creek enters it from the east, near its central line, and flows diagonally across it, leaving the township in its north-western corner. Crow's run is the only other stream of any importance, and drains the southern portion of the township.

The horizon of the Upper Freeport coal is exposed throughout the entire course of Brush creek, and for some distance along Crow's run, and along the Ohio river front of the township; but with these exceptions, the surface is occupied entirely by the Barren Measures.

Passing up Crow's run, from the point where we left it at the Economy line, we find a great many openings have been made on the *Darlington coal* along that stream. Just in the edge of the township, we see the following, on the land of Mrs Robinson 182′: (Fig. 153.)

1. Massive Sandstone, Mahoning, seen,	30′
2. Concealed,	100′
3. Massive Sandstone, Freeport,	40′
4. *Coal*, Darlington, (Upper Kittanning)	1′ 8″
5. Concealed to Crow's Run,	10′

Here, at the top of the hill, is a quarry in the Mahoning Sandstone, on the land of Mrs. Robinson. The bottom of the stratum is not seen, but the rock shows a massive face of 30 feet to top of the hill. The rock is a very fine building stone, and contains many quartz pebbles in some parts of it.

Everything is covered up in the interval, No. 2. The Freeport Sandstone is seen in a vertical cliff along the stream, and is somewhat flaggy in its lower part.

The Darlington coal is quite pure, and is a very rich, oily coal, having a bright shining luster. There is one half foot of slaty *cannel* on top of it here

Passing up the stream we find the last opening in the Darlington coal before it sinks below water level on the land of Mr Smith, just below the forks of Crow's run, where it is 20 to 22 inches thick, with the slaty *cannel* still seen resting on its top

Just above the forks of the stream, we get the following, in descending a steep hill to the creek near the old mill site 130′: (Fig. 154.)

1. Massive Sandstone, Mahoning, seen,	40′
2 Concealed,	5′
3. *Limestone*, Freeport,	2′
4. Concealed,	20′
5 Sandy Shales,	35′
6. *Coal*, Lower Freeport,	1′ to 2′
7. Sandy Shales,	8′
8. *Limestone*, Butler,	3′
9. Sandy Shales to the level of Crow's Run,	15′

The Mahoning Sandstone attains a large development and numerous quarries are being operated on it here. It is a very massive stratum, and is a grayish white rock, which splits into blocks of any size, and dresses quite freely. A vast quantity of building stone has been hauled from this locality to Baden, and shipped on the Pittsburg, Fort Wayne and Chicago railroad to Pittsburg and other cities.

The Upper Freeport coal is doubtless very thin, as only a small blossom of coal is seen in No. 2

The Freeport Limestone occurs along the road, which descends to Crow's run at this point. It is a light gray, compact rock, and weathers with a peculiarly wrinkled appearance. It is buff on its weathered surface.

The Lower Freeport coal has been stripped along the hill and used in burning the limestone below it. It varies from one to two feet in thickness, and is quite slaty in places. Just above the old mill it has been drifted upon by Mr. Smith, and is there two feet thick, with a parting of slate one inch thick near the middle.

The Butler Limestone has been quarried and burned. It is a very rough looking rock, being very much brecciated, and containing small nodules of *iron ore* sticking out over it. It is of a grayish blue color and non-fossiliferous. It is said to have made very good lime, though it was quite difficult to slack.

A boring was once made for *oil* at this point, and a coal is reported at 75 feet below the Lower Freeport—this would be the Darlington

Passing up Crow's run, above this the Mahoning Sandstone dips rapidly down, and is soon seen forming a massive wall on either side of the stream, which here flows in a mere gorge, cut out of this rock, and it finally passes below the stream one mile above the old mill site; then the fall of the stream is much less rapid, and the strata soon commence to rise faster than the stream's bed, and where the Mahoning Sandstone re-appears one and a half miles above it is a mere mass of sandy shales.

Near the head of Crow's run, the Brush Creek coal is mined on the land of Mrs. Steel, and there we get the following section of it· (Fig 155.)

1. Dark Shales,			8′
2. Coal (Brush Creek), . .	1. Coal,	2′	2′ 6½″
	2 Slate,	0′ ½″	
	3. Coal, .	0′ 6 ″	

Blocks of the Brush Creek Limestone are seen in the debris above the mouth of the bank, but its exact horizon was concealed. The coal has a dull slaty look, and is rather poor. It is mined for local supply

Passing up on the hill above this we come to the Crinoidal Limestone, near the Baptist church, 195 feet above the coal. The red clay is there seen under it near the church.

A short distance east from Mrs. Steel's opening, the coal is mined on the land of Mr. Lovell, at whose drift we see the following: (Fig. 156.)

1. Limestone, Brush Creek,			1′
2. Dark Shales,			12′
3 Coal (Brush Creek),	1 Coal,	2′ 0″	2′ 7″
	2 Slate,	1″	
	3. Coal,	6″	
4. Fire Clay, seen,			2′

Mr Lovell mines this coal quite extensively for country supply, as there is no other coal near, except Mrs. Steel's. The coal is very fair looking and is bright and lustrous.

Mr Lovell says the smiths have used it successfully.

Passing over to Brush creek, we find the Freeport Limestone exposed in the bank of the creek where the road crosses it just below Harkin's saw-mill Here the limestone is 3 to 4 feet thick in two layers.

The coal above it is only 10 inches thick, as proven by Mr. Harkin, who sunk a small shaft to it through the surface dèbris. One mile above this, just in the edge of Butler county, it is four feet thick.

The Mahoning Sandstone is quite massive, and Mr. Goehring has a quarry in it near the saw-mill.

Keeping on down Brush creek in a north-west direction, the Upper Freeport coal and its underlying Limestone are frequently seen, though the coal does not attain workable dimensions. The strata keep pretty much on the same level, neither rising no falling until we come to Unionville. Here the Upper Freeport coal was once mined on the land of Mr. Burns, at the road-side near Noss's saw-mill, where it is reported to have been 2 feet thick.

One half mile south from Unionville on a small stream, the Upper Freeport has been mined on the land of Mr. Casper Zahn, where we see the following 40′: (Fig. 157.)

1. Massive Sandstone, Mahoning, seen,	20′
2. Concealed,	5′
3. *Coal*, Upper Freeport,	1′ 6″ to 20″
4. Fire Clay,	2′
5. *Limestone*, Freeport,	2′

Here the Mahoning Sandstone is quarried on the land of Mr. Lutz. It is a very firm, compact rock, and makes a splendid building stone.

The coal below it has been mined and also stripped out of the little bottom. It is only 18 to 20 inches thick, but of excellent quality. The Freeport Limestone, below it, very nodular and ferruginous.

Descending the Rochester road to Unionville, we see following exposure of 225′: (Fig 158.)

1. Sandy Shales,	45′
2. *Coal,*	1′
3 Sandstone and Sandy Shales,	80′
4. Black Carbonaceous Shales,	10′
5 Variegated Sandy Shales,	60′
6. Fire Clay, with a streak of Coal at the top,	4′
7. Mahoning Sandstone,	35′
8. *Coal,* Upper Freeport,	Blossom.
9. Concealed to the level of Brush Creek,	40′

No. 4 is very probably the horizon of the Brush Cre coal. Just across the lower bridge at Unionville, the Up Freeport coal is seen in Mr. Zahn's spring-house, where is 18 inches thick and 45 feet above the creek One h mile below this a coal was once opened and mined on t land of Mr. Burns at an elevation of 100 feet above t creek, and 50 feet above the Upper Freeport coal. T mine is not now in operation, but it is reported somewh slaty, which made it extremely hard to dig.

Two miles below Unionville the Upper Freeport coal mined on the land of Mr. Cunning, and there we see t following 80′: (Fig. 159.)

1. Sandy Shales,	5 ′
2. Coal, Upper Freeport,	0′ to 4 ′
3. Fire Clay,	3 ′
4. Limestone, Freeport,	2½′
5. Concealed to level of Brush Creek,	65 ′

Here the Upper Freeport becomes locally workable. is quite variable, however; for, when followed to the sout it runs out almost entirely, but, in other directions, it thic ens up to 4 feet. The coal is very bad, being full of py tous slate, and burns out a grate in a very short tim

Big Knob, an index of the former extent of the C Measures northward.

Near the center of the township, a high knob of land, oval or elliptical shape, extends up 300 feet above a of the surrounding hills. This is known as Big Knob. can be seen for a long distance, and is the most elevat point in the district, its summit being about 1,450 feet above tide. I was anxious to know what had preserved this elevated point from the erosion which has leveled down all its neighboring hills, so, ascending it, I found a steep escarpment extending around it near the summit, and this is formed by the *Morgantown Sandstone*, which there caps the hill and has preserved it from the general waste This massive sandstone is known to be the Morgantown, because the Crinoidal Limestone is seen 100 feet below the summit of the knob. Standing on this elevated point and gazing out on the hills and valleys, far below, one can form some idea of the tremendous *erosion* to which the coal rocks have been subjected, and of the former northward reach of strata, now only seen far to the south; for this is the only point at which the Morgantown Sandstone is seen for 15 miles to the south-east.

At Freedom we get the following section descending the steep hill back from the village to Dutchman's run 287′: (Fig. 160.)

1. Shaly Sandstone, Mahoning, seen,		[illegible]
2. *Coal*, Upper Freeport,		Blossom.
3 Concealed,		100′
4. *Coal*, Darlington,	(Upper Kittanning)	Blossom.
5. Shales, and concealed,		50′
6. *Coal*, Kittanning,	(Lower Kittanning)	2′ 6″
7. Fire Clay,		10′
8. Concealed to the level of the Ohio,		100′

Here the Kittanning coal has been mined at several points along Dutchman's run. It is utterly worthless, however, and seems only to be used when nothing else can be obtained. The fire clay under it is very good, and is manufactured into fire brick by Mr. Bryon, of which it makes an excellent quality.

33. *Rochester Township, Beaver County.*

This is a small area, which surrounds and includes the borough of Rochester, at the mouth of the Big Beaver.

It borders on the Ohio and Big Beaver rivers, and all the streams passing through it are small, heading up in the highlands, and descending with a rapid fall to the rivers.

A short distance above Freedom, the Kittanning coal is mined on the land of Mr. Lacock, and there it shows the following structure 112′: (Fig. 161.)

1. Coal,	Kittanning Coal.	8″	2′ 5″
2 Slate,		1″ to 2″	
3. Coal,		1′ 8″	
4. Fire Clay,			10′
5. Concealed to the Ohio River,			100′

This coal is very bad, containing so much pyritous slate as to be almost worthless. The fire clay below it is quite pure, however.

Gas-well.—About half way between Rochester and Freedom, the Rochester Tumbler Co bored for gas. A record was kept on a black-board in the drill-room, and, when gas was struck, it caught fire, and derrick, record, and all were consumed, so that very little could be learned of the succession. However, a sand was struck at 915 feet, which flows from seven to eight barrels of a dark green oil per week The well commences 75 feet below the Kittanning coal; hence this oil comes from one of the Butler county oil-sands. The interval here, from the Kittanning to the Upper Freeport, is 180 feet, which, added to the other intervals, give 180+75+915=1,170 feet *oil-horizon below Upper Freeport coal.* In Butler county, the interval between the Upper Freeport coal and the first oil sand is 1,150 to 1,200 feet. The oil obtained at Rochester is 47 gravity. Considerable gas is obtained in the same oil-rock, and is used in the manufacture of tumblers.

The *terraces* at the mouth of the Big Beaver have been described in the general discussion.

Just above the mouth of the Big Beaver, we get the following section of 148′ on its left bank: (Fig. 162.)

1. Shaly Sandstone, . .		. . .	10′
2. *Coal*, Darlington, ...		. .	1′ 2″
3. Shales, containing Iron Ore at bottom,		.	30′
4. *Coal*, Kittanning, . .	1. Coal, . .	6″	2′
	2. Slate, . .	1″	
	3. Coal, .	1′ 5″	
5. Fire Clay, seen, ...	. . . .	. . .	5′
6. Concealed to the level of the Ohio River,		. . .	100′

Here the Kittanning coal is mined by Mr. Fell. It is quite impure, containing much sulphur, in binders, and is also slaty. It is separated into two benches by a parting of hard sulphurous slate, which varies in thickness from 1 to 2 inches. The coal below this parting is better than that above

The Darlington coal was once opened immediately above the Kittanning, but it was only 14 inches thick, and was not followed further.

The fire clay under the Kittanning coal is very pure and good, and is used in the manufacture of fire-brick

One fourth of a mile above this, McKinley's run puts into the left bank of the Beaver, and along it the *Kittanning coal* is extensively mined

In ascending the run, the first works are Mr. Smith's, then Mr Moulter's, and last, just before the coal passes under the stream, it is mined by Mr. McLaughlin, at whose drift we see the following 92′: (Fig. 163.)

1. Sandstone, Freeport, tolerably massive,			50′
2. Sandy Shales,			10′
3. *Coal*, Darlington, (Upper Kittanning)			1′ 4″
4. Shales,			25′
5. *Coal*, Kittanning,	1 Coal,	7″	2′
	2. Slate,	½″ to 2″	
	3. Coal,	1′ 5″	
6. Fire Clay, seen,			4′

The coal is quite sulphurous, though, with care, it can be much improved, since the most of the sulphur comes out in large "binders," which can be removed with a little trouble. The coal shows the same section at all the banks on this run.

Three fourths of a mile above the mouth of McKinley's run, Whistler's run puts into the Big Beaver through Bridgewater, and a short distance up it we see the following, at the coal-works of S. Barnes & Co., 126′: (Fig. 164.)

1. Dark Shales, containing Iron Ore,			20′
2. *Coal*, Kittanning,	1. Coal,	6″	2′
	2. Slate,	1″ to 2″	
	3. Coal,	1′ 5″	
3. Fire Clay,			7′
4. Sandstone and Sandy Shales,			60′
5. *Limestone, Ferriferous*,			1½′ to 2′
6. Concealed to the level of the Beaver,			35′

The coal is of tolerably fair quality here, having much less sulphur in it than at the banks below. It is richly bituminous in the lower part, and is lustrous and brilliant.

The *Kittanning fire clay* is of superior quality. This is the bed from which the large fire-brick manufactory of S. Barnes & Co., of Bridgewater, obtains its clay. The fire-brick and furnace lining made there are highly recommended by the iron men of the Mahoning and Shenango valleys. Only about five to six feet of the fire clay is used, as the lower part is too silicious. It is very hard when first taken out, but soon moulders down to a plastic clay.

The Ferriferous Limestone makes its first appearance in the section at this point, it having been concealed in all those below this, along the Beaver and Ohio. It is about ten feet below the level of the railroad track, and is somewhat impure. It is filled with its common fossils, viz: *Spirifer cameratus*, S. *lineatus*, *Productus longispinus*, *Chonetes mesoloba*, &c.; and also an abundance of Crinoidal fragments.

Mr. Lord mines the Kittanning bed opposite Barnes' opening.

One half mile above the mouth of Whisler's run, the coal is mined by Mr. Moore, and there we see the following. (Fig. 165.)

1. Coal, Kittanning, . .	2'
2. Fire Clay, . .	8'
3. Sandstone and Shales, ...	42'
4. *Limestone, Ferriferous*, seen to the level of the R. R. track,	5'

Here the Ferriferous Limestone has become quite massive, and has resumed that peculiar weathered appearance which it so often presents when of considerable thickness; it has a shriveled aspect, from its face being traversed with wavy lines of weathering. It is a very compact, hard, bluish gray rock, and crowded with fossils.

34. *Pulaski Township, Beaver County.*

This lies immediately north from Rochester, and partly surrounds the latter on the east. The Big Beaver river forms its western boundary, and it encloses the borough of New Brighton, which occupies the banks of the same stream. Block-house run is the only stream of any consequence which flows through it. This rises in the eastern and northern parts of the township, and empties into the Beaver, just below New Brighton borough.

Most of the surface is occupied by the Lower Coal Series, but, in the eastern part of the township, the Barren Measures cover up everything after the Upper Freeport coal has got beneath the streams

Passing on up the Beaver from where we left off in Rochester township, we find Paved run putting into Blockhouse, a short distance above the latter's mouth, and, on this little stream, we get the following section of 214′ on the land of Messrs. Chamberlin & Mendenhall. (Fig 166.)

1. Massive Sandstone,		30′	Freeport,	45′
2. Coal, (local)		0′ 5″		
3. Sandstone,		15′		
4. *Coal*, Darlington,				. 1′ 6″
5. Shales, containing Iron Ore,				25′
6. *Coal*, Kittanning,	1 Coal,	6 ′		2′
	2 Slate,	½″ to 3″		
	3. Coal,	1′ 6″		
7. Fire Clay,				6′
8. Shaly Sandstone,				54′
9. *Limestone, Ferriferous*,	1. Limestone,	2½′		8′ 6″
	2 Shale,	1½′		
	3 Limestone,	1 ′		
	4. Shale,	3 ′		
	5. Limestone,	½′		
10. Dark Shales,				15′
11. Concealed to level of Beaver,				65′

The *Kittanning coal* is mined by Chamberlain & Mendenhall. It is a tolerably fair coal, though it contains considerable sulphur

The Darlington coal is exposed above it, and is seen to be a very pure coal.

The shales separating these two coals, contain immense quantities of *iron ore*, in huge nuggets.

Coal bed in the Freeport Sandstone—No 2 is a local streak of coal which here comes in the Freeport Sandstone, the upper part of which is massive.

The Ferriferous Limestone shows a queer freak of splitting up into three layers, separated by shales. Each layer is quite compact, and crowded with fossils. It was once quarried near here, and burned.

The Kittanning Fire Clay is very good.

Three fourths of a mile above this we get the following section of 220′ descending the hill past the Terra Cotta-Works of Messrs. Elverson & Sherwood: (Fig. 167.)

1. Massive Sandstone, Butler,			25′
2. *Coal*, Lower Freeport,			Blossom.
3. Concealed,			80′
4. *Coal*, Darlington,	(Upper Kittanning)		1′ 4″
5. Fire Clay,			3′
6. Shales,			26′
7. *Coal*, Kittanning,	1. Coal,	6″	2′
	2. Slate,	1″	
	3. Coal,	1′ 5″	
8. Fire Clay,			8′
9 Shales and Shaly Sandstone,			55′
10. *Limestone*, Ferriferous,			3′
11. Shales,			8′
12. Concealed to level of Black House Run,			14′

The Butler Sandstone No. 1, has been quite extensively quarried by Mr. Smith. It is a very compact, coarse, yellowish white rock, and makes a fine building stone.

The Lower Freeport is represented by the blossom of a coal seen at the base of this sandstone.

A fine *terrace* occurs 20 to 25 feet below the level of this last stratum; it is covered with a very thick coating of clay, which is used in the manufacture of plant pots, by Messrs. Elverson & Sherwood.

The Darlington coal is seen in the bank near the Terra Cotta-Works.

The Kittanning coal mined here is a very superior coal, being pitchy, brilliant, and free from the pyritous slate, which renders it so bad at other mines. It is used at the Terra Cotta-Works in burning their wares.

The Kittanning under-clay at this locality is a superior article for terra cotta ware. It is manufactured by Messrs. Elverson & Sherwood into all kinds of flower pots, vases, rustic baskets, statuary, &c. The wares of Elverson & Sherwood received the first premium over all competitors of their class at the Pittsburg Industrial Exposition in 1875. The Terra Cotta establishments along the Ohio river which get their clay from this same stratum were then in competition. Clay of three grades of fineness is used in making different articles.

Messrs. Elverson & Sherwood inform me that the clay which has been exposed along the edge of the rock, or rather where there is no rock covering, is the best for terra cotta ware, as it vitrifies with more ease.

The Kittanning coal is also mined here by Mr. Couch, Smith, and others.

The Ferriferous Limestone was once quarried, and burned for cement, which was used in building the locks on the old Erie and Pittsburg canal. It is impure and sandy, but filled with fossils, *Productus longispinus* being especially abundant

Above this one fourth of a mile, and opposite Butler Street, the coal is mined by 'Squire Glass, who also has a fire-brick establishment, and descending to the run we get the following section of 92′· (Fig. 168.)

1. Dark Shales, containing Iron Ore, . . .			10′
2. Coal (Kittanning),	1 Coal,	7″	2′
	2 Slate,	1″	
	3 Coal,	1′ 4″	
3. Fire Clay,			8′
4. Sandy Shales and Sandstone,			. 60′
5. *Limestone, Ferriferous,* .			2′
6. Concealed to level of Block-House Run,. .			10′

Here the Kittanning *under-clay* is burned into fire-brick at the establishment of Mr. Glass.

The Ferriferous Limestone has been quarried out along the road for burning. It is somewhat impure, as it always is, when thin.

Up Block-House run, one mile above Glass's, we come to several openings in the Kittanning coal, among which are those of Mr Fish, Evan's, Funkhauser, and others. The coal is not so pure as at the Terra Cotta-works, containing considerable sulphur and slate.

The Darlington Blacksmith Coal:—

Mr. Bentley has an opening in the Darlington coal a short distance above Mr. Fish's; it is 18 inches thick, and 35 feet above the Kittanning. It is remarkably pure, and free from sulphur, and is termed the "Blacksmith coal," as it is prized by the smiths, above all other coals. It is richly bituminous, and the layers of bitumen are interlaminated with mineral charcoal.

The Kittanning coal is last mined by Mr. Barrett, a short distance above this, at the forks of the run, by a shaft 18 feet deep, as the strata are dipping rapidly to the east. Descending from the summit of the hill at this point we get the following section of 205′: (Fig. 169.)

1. Massive Sandstone, Mahoning,	30′
2. Concealed,	50′
3. *Coal, Lower Freeport,*	1′ 2″
4. Sandstone, Shales, and concealed,	80′
5. *Coal*, Darlington, (Upper Kittanning)	1′ 6″
6. Sandstone and Shales,	40′
7. *Coal*, Kittanning, in Barrett's shaft,	2′

The Mahoning Sandstone is very massive, and huge blocks of it are scattered over the hill. On another hill, just across from this to the west, this rock is quarried extensively by Mr. Fish. It is a fine building stone; some quartz pebbles occur in it.

The Upper Freeport coal is seen under it at Mr. Fish's quarry, running from 2 to 8 inches in thickness, and at times thinning out altogether.

The Lower Freeport coal is seen along the hill-side, where some one has attempted to open it. It is too thin and slaty to be of any value, however.

The Darlington coal has been stripped out all along the hill-side, and in the little bottom above, where it comes down to the run.

Ascending the right or east branch of Block-House run, the strata dip down, and pass under the stream, successively, and the massive Mahoning Sandstone keeps the walls of the same almost vertical on either side. One mile above the forks of the run, Mr. McClellan is drifting for the Upper Freeport coal. When I visited the locality he had just struck it at the outcrop, and it showed a thickness of only 1 foot.

Near the head of this branch, we get the following section of 62′ on the land of Mr. Thomas: (Fig. 170.)

1. Massive Sandstone, Mahoning,			40′
2. *Coal*, Upper Freeport,			1′ to 2′
3. Fire Clay,			5′
4. *Limestone*, Freeport,	1. Limestone,	2′	5′
	2. Shale,	½′	
	3 Limestone,	1½′	
	4 Calc Shale,	1′	
5. Sandy Shales to level of the run,			10′

The Upper Freeport coal has been mined and used, in burning the underlying limestone It is at times 2 feet thick, and again is cut entirely away by the massive sandstone, which rests directly upon it The coal is quite good, what there is of it.

The Freeport Limestone has been burned. The upper stratum only was used, as the lower is impure and ferruginous It is said to have made excellent lime. The stone is very hard and compact, of a light gray color and non-fossiliferous.

The U. Freeport coal dips under the stream a few rods above this, and has there been mined by stripping along the little bottom Above the coal rise hills of the Lower Barren Measures 150′ to 200′ high, but no exposures occur in them.

Returning again to the forks of Block-House run and ascending the left or north branch, we find the Darlington coal has been mined both by drifting and stripping near its mouth. None of the banks are in operation now, however, and the coal soon passes under the stream, owing to the rapid fall of the latter. The massive Mahoning Sandstone forms cliffs along each side of the stream as we ascend, and 1½ miles above the forks we get the following section of 63′ on the land of Mr Ferguson: (Fig. 171.)

1. Massive Sandstone, Mahoning, seen,	30′
2. Coal, Upper Freeport,	1½′
3. Fire Clay,	4′
4. Limestone, Freeport,	3′
5. Sandy Shales to level of run,	25′

Here the Mahoning sandstone is very compact and massive, and is quarried extensively on the land of Mr. Ferguson. It is a rather coarse, yellowish-white rock, splits freely into blocks of any desired size, and dresses easily. It is composed of minute grains of quartz, and very little mica is seen in it.

The Upper Freeport coal bed is only 1½ feet thick, and the sandstone rests immediately upon it The limestone below the coal is very hard and compact, breaking with a sharp clear fracture One quarter mile above this both the coal and limestone pass under the stream, and are seen no more until we cross the divide to the waters of Brush creek and Connoquenessing.

The First Beaver Falls Long Section of 374′.

Returning to New Brighton, and passing up Beaver, we find the hills rising in nearly vertical cliffs, after we pass the dam at Beaver Falls The whole series, from the Upper Freeport down to the Piedmont sandstone, is here exposed.

Trough run puts into the Beaver, one half mile above the dam It falls 400 feet in about one mile, and cuts a steep and narrow gorge out of the rocks in its path. The strata are finely exposed along it, and the stream is frequently interrupted by falls and cascades, which make it a delightful retreat in the heat of summer. A section of 374′ can be got in descending the run from the hill road, near Mr. McGuire's: (Fig 172.)

Trough Run Section

1. Mahoning Sandstone,			20′
2. Coal, Upper Freeport,			Blossom.
3. Fire Clay, and concealed,			5
4. Sandstone, Shaly at top, massive below,	(U F. SS)		60′
5. Coal, impure cannel, Lower Freeport,			2′
6. Sandy Shales,			10′
7. Massive Sandstone, Freeport,	(L. F. SS)		65′
8. Shales,			4′
9. Coal, Darlington,	(Upper Kittanning)		1′ 10″
10 Shales, containing Iron Ore,			40′
11. Kittanning Coal,	(Lower Kittanning)		2′
12. Fire Clay,			10′
13. Sandstone and Sandy Shales,	(Kittanning SS.)		70′
14. Limestone, Ferriferous,		6″ to	2′
15. Dark Fossiliferous Slate,			10′
16. Shales and Sandstone,			15′
17. Coal, Clarion,		1′ to	2′
18. Fire Clay,			10′
19. Sandstone and Shales to level of Big Beaver,			45′

The Upper Freeport coal is seen as a blossom in the road near Mr McGuire's.

The Upper Freeport Sandstone.

The sandstone below the coal is quite massive in its lower part, and huge blocks of it are scattered over the hill, mingled with that from No 1, the Mahoning After leaving the road, this stream enters the rock, and has cut for itself a deep narrow channel, with almost perpendicular walls on either side

The Lower Freeport coal is an impure cannel, and on one of the side ravines shows a thickness of 3′ Mr. Hoopes once attempted to mine it here. but it was so impure and worthless, that it was abandoned.

The Lower Freeport Sandstone.

The Freeport Sandstone proper is not so massive as usual, the upper half being quite shaly and flaggy, but the lower part is massive, and forms a steep bluff on either bank of the stream.

The Darlington coal is seen fully exposed in a bank of the run, and is a very bright, pure, rich coal Not a sign of copperas is seen on it its exposed surface The shales between it and the Kittanning coal contain immense quantities of *iron nodules*, some of which are a foot in diameter

The Kittanning Sandstone immediately under the fire clay below the Kittanning coal, is here quite massive, and the stream makes a plunge of 20′ over it to the more shaly portion below

The Ferriferous limestone is very well exposed along the run for several rods, and is seen to vary from 6″ to 2′ in thickness, within short distances. It is very impure, and shows the "*cone in cone*" structure very finely. It contains few fossils, but the calcareous shales immediately below it are filled with them.

Fossils of the Ferriferous Limestone Under-slate :—

At this locality I have seen the following: *Spirifer cameratus*, *Productus Nebrascensis*, *P. longispinus*, *P semireticulatus*, *P. Prattenanus*, *P. costatus*, *Athyris subtilita*, *Chonetes mesoloba*, *Hemipronites crassus*, *Euomphalus rugosus*, *Bellerophon carbonarius*, *B. Stevensanus*, *B. per-*

carinatus, *B. montfortianus*, *Aviculo-pecten Whiteii*, *Nucula ventricosa*, *Nuculana bellistriata*, *Nautilus occidentalis*, *Nautilus sp ?*, *Polyphemopsis peracuta*, and many others

The Clarion coal is seen in the vertical cliff, constantly exposed from the mouth of Trough run down to the dam. It is seen to vary in short distances from 1′ to 2′ in thickness The coal is evidently impure, as its exposed surface is frosted over with copperas

Plant bed —About 10′ above the base of No. 20 occurs a stratum containing many remains of plants, but they are in such a fragmentary condition that they cannot be identified.

This brings us down to the top of the Piedmont or Homewood sandstone, which is here, in the bed of the river in a solid stratum all the way across it.

The Second Beaver Falls Long Section of 414′.

One half mile above this, opposite the ax factory of Joseph Graff & Co , the hill rises at an angle of 30°, and the whole section is finely exposed, from the top of the Mahoning sandstone down to the Piedmont SS., or base of the Lower Productive Series, 414′ in succession: (Fig 173.)

1. Very massive Sandstone, Mahoning,		40′
2. Shales,		1′ to 2′
3. Coal, Upper Freeport,		3′ to 4′
4. Fire Clay,		2′ 6″
5. Limestone, Freeport,		3′
6. Sandy Shales,		35′
7. Massive Sandstone, Butler,		30′
8. Coal, Slaty, Lower Freeport,		1′ 4″
9. Fire Clay, and concealed,		3′
10. Sandy Shales and Sandstone, Freeport,		75′
11. Coal, Darlington,		1′ 8″
12. Sandy Shales, containing Iron Ore,		35′
13. Coal, Kittanning,	1. Coal, 6″ 2. Slate, 1″ 3. Coal, 1′ 10″	2′ 5″
14 Fire Clay,		12′
15. Sandstone and Shales,		70′
16. Limestone, Ferriferous,		1′ to 6″
17. Dark Calcareous Shales, Fossiliferous,		5′
18. Sandstone and Shales,		20′
19. Coal, Slaty, Clarion,		1′
20. Sandy Shales,		40′
21. Concealed to level of Big Beaver,		30′

Here the Mahoning Sandstone is seen capping the hill with perpendicular cliffs, while the coal bed fully exposed immediately under it forms a broad black band around its top conspicuous from a distance The coal has never been mined, because there is no way of access to it It looks quite good, however, and though constantly exposed to the weather, remains in a solid mass and shows very little copperas on its surface.

The Freeport Limestone is seen in two layers The upper is very compact and 1½′ thick, while the lower is somewhat ferruginous and nodular; both layers are much brecciated.

The Butler SS. No 7, like the Mahoning, forms a perpendicular cliff along the hill It is a tolerably coarse, whitish sandstone of unequal composition, which causes it to weather into great holes and cavities.

Cannel Coal. Origin of a bed illustrated. About five rods above our line of section there occurs midway in No. 10 a local bed of *cannel coal* It was opened here in the hill a long time ago, but no one seems to know anything about it now. At the mouth of the old drift we see 5′ of cannel which, though somewhat impure, would doubtless burn very well. It rests immediately on sandy shales, and when followed to the south toward our line of section runs entirely out in a very few feet from the mouth of the old drift. This is certainly a fine illustration of the origin of our cannel coals, viz: vegetable matter accumulated by drifting into lagoons This must be a mere pocket, for at the next exposure only a few rods above there is no coal at this horizon or anywhere between the Lower Freeport and the Darlington coals.

The Kittanning coal is mined here on the land of Mr. McGuire, by Mr John Ebner, who conveys it across the Beaver from the mouth of the pit, in baskets, on a wire cable stretched across for that purpose. Here we have an excellent illustration of the necessity of consultation with a geologist before undertaking any mining enterprise. Mr. Ebner was told by some "practical" miners that coal always rises and drains itself *when followed to the east;* so he took for granted it would do so in this case, and erected his coal-works and cable at a cost of $5,000. Now it happens that the coal instead of rising to the east dips very rapidly in that direction, and will so continue for several miles Owing to the topography he was compelled to drift in that direction, and the cutting of the drain has entailed a very large expenditure, and as it has constantly to be deepened as the entry advances, the expense must continue to increase, since the terms of his lease from McGuire bind him to take out 1,000 tons per year, or pay the royalty on that amount Had Mr Ebner consulted a geologist he would have advised him to erect his works one half mile below, at the mouth of Trough run Then commencing his entry where the coal passes under on that stream, and driving it north, the mine would have drained itself, and he could have taken out nearly all the coal in the McGuire tract. In fact the entry will have to be drained from Trough run yet, or the works be abandoned.

The coal is quite pure and good, and is rich in volatile matter, being used for gas at the Beaver Falls gas-works.

The rest of the section below the coal was obtained in a ravine which puts into the Beaver a few rods above Mr Ebner's coal-works

The concealed portion at the bottom is occupied by the Piedmont Sandstone; for we see it exposed just above the mouth of the ravine.

Passing up the Beaver from here we see the massive Piedmont Sandstone rising quite rapidly, and soon forming cliffs along the stream. It is a coarse, hard, whitish sandstone, and shows much cross-bedding and oblique lamination. It contains many trunks and branches of trees

35. North Sewickley Township, Beaver County.

This lies immediately north from Pulaski and extends into the narrow neck between Connoquenessing creek and Big Beaver river, north, to the Lawrence county line. The Big Beaver river forms its western boundary, while the Connoquenessing flows along its north-eastern border. Brush creek flows along just outside of its eastern line until within a short distance of the Connoquenessing, where it enters the township, and empties into the Connoquenessing 1 mile below. Bennett's run, a small stream, empties into the Beaver from the east in the southern part of the township.

It will be seen that the township is mostly highland, with deep drainage all around it, while all the streams passing down from its slopes are small.

Continuing our description along the Beaver river from where we left off in Pulaski township, the strata continue to rise quite rapidly, until, near the southern line of the township a ravine puts into the Beaver, on which we get the following section, 347′ high: (Fig. 174.)

1. Massive Sandstone, Butler,			35′
2. Concealed,			5′
3. Shales and Sandstone, Freeport,			75′
5. Coal, Darlington,	1. Coal,	1′ 6″	1′ 10″
	2 Slate,	1″	
	3. Coal,	3″	
6. Fire Clay,			5′
7. Shales, containing Iron Ore,			30′
8. Coal, Kittanning,			2′ 4″
9. Fire Clay,			10′
10. Sandstone and Sandy Shales,			70′
11. Limestone, Ferriferous,			1′ to 1½′
12. Black Fossiliferous Shales,			12′
13. Concealed,			10′
14. Massive Sandstone, Piedmont,			75′
15. Concealed to level of river,			15′

Here the Butler Sandstone is quite massive, and immense blocks of it cover the hillside, commingled with the Mahoning, which comes down from above

The Lower Freeport coal was not seen, its place being concealed, but as the fire clay shows the coal is probably present.

The Freeport Sandstone is a mass of sandy shales, except 20′ of its base, which is massive.

The Darlington coal was once opened here, on the land of Mr. Fetterman, and mined to some extent. It is very pure and brilliant looking. A small streak of slate is seen 3″ above its bottom.

The Kittanning coal is fully exposed in the ravine, and shows the same parting of slate below the top which characterized it at New Brighton.

The Ferriferous Limestone shows here the "*cone in cone*" structure which is so common with it when thin.

The shales below the limestone are quite rich in fossils. In them I once obtained a beautiful specimen of *Pleurotomaria carbonaria*. The lower part of the black shales is a mere mass of *Aviculo-pecten Whiteii*, to which are attached countless numbers of *Spirorbis carbonarius*.

The Piedmont Sandstone, (or Upper Homewood SS.) is seen in an immense cliff along the stream, while huge blocks of it lie scattered over the ground. For the most part it is a coarse, grayish-white sandstone, but some portions of it contain pebbles. It very probably extends down to near the level of the river.

Oil well boring.—A short distance above this a boring was once made for oil, commencing but a few feet above the base of the sandstone. No oil was obtained, but a heavy vein of gas was struck at something over 900′. The well is 982′ deep. No record of the original boring was kept, but the Economy Society recently purchased the well, and Mr. Ramsey, who drilled the deep well at Beaver Falls, reamed the well out for 657′ and kept a very careful record in bottles which shows the following succession: (Fig. 175.)

1. Conductor hole,	18′
2. Shales, containing much Iron Ore, (base of Piedmont,)	7′
3. Darkish Sandy Shales,	39′
4. Dark Sandstone,	3′
5. Black Slaty Shales,	53′
6. Dark Argillaceous Shales,	14′
7. White hard Sandstone, Connoquenessing,	46′
8. Dark Sandy Shales,	44′
9. Hard brownish Sandstone,	24′
10. Sandy Shales,	48
11. Hard blueish Sandstone and Shale,	78′
12. Bluish, Sandy, and Argillaceous Shales,	160′
13. White Pebbly Sandstone, (First Oil Sand,)	102′
14. Blue Sandy Shale to bottom of reaming,	5′

The gas comes somewhere about 900 feet. No one knows certainly. It may be from the 3rd oil sand horizon. The well commences 25′ above the level of the river. No. 2 is about the base of the Piedmont sandstone, the base of which is here just rising above the level of the river.

No 7 is the rock of the top wall along the Connoquenessing above here, while No. 9 is the one which is frequently seen in the bed of the same and along the bottom wall of the cañon

Nos 10 to 12.

No 13 is the First Oil Sand. This is evidently the same rock in which the oil occurs at Smith's ferry It is quite pebbly, and some of the pebbles brought up were as large as hazel-nuts. The gas from this well furnishes more than can be made use of at the cutlery-works, and is also mixed with the illuminating gas. Considerable salt water is found in No. 13, and the well was reamed out to case this off The pressure on the meter shows from 15 to 20 lbs The record here agrees very well with that obtained at Beaver Falls in Economy well No. 2.

One half mile above the Economy well Bennett's run puts into the Beaver over a massive cliff of the *Piedmont Sandstone*, and there we get the following section of 278', descending a steep hill to the river: (Fig. 176.)

1. Coal blossom, Kittanning,		?
2. Fire Clay,		8'
3. Concealed,		80'
4. Sandstone, somewhat massive,	Piedmont,	45'
5. Massive Conglomeratic Sandstone,		115'
6. Concealed to river, .		30'

No. 1 is seen here in an old quarry of some kind It is the Kittanning, as this is its proper horizon, and then the large bed of Fire Clay below confirms the conclusion.

No 4 is properly a part of No 5, as there is no division plane, except that this part of the rock is not quite so massive as the lower.

As for No 5 itself, it is an immense stratum, and Bennett's Run passes over it in a series of falls and cascades, with huge blocks of the conglomerate strewn around on either side, rendering the scenery wild in the extreme Many layers of this rock are a perfect mass of small pebbles, while the rest of the rock is a coarse, whitish sandstone No pebbles occur in it larger than a hazel-nut The base of No. 5 is the bottom of the sandrock; for although everything was concealed below it, the topography shows that a shale comes below.

Up Bennett's run we see the Kittanning and Darlington coals near the forks of the stream. Here on the left branch of the run the Darlington has been extensively mined on the land of Mr. Dougherty. It is an excellent coal, having a rich bituminous luster and showing very little slate or sulphur It is so far superior to the Kittanning that many families in New Brighton and Beaver Falls get their coal here in preference to the Kittanning, which is at their doors. At Dougherty's bank the coal is 2½ to 3′ thick and has a thin parting of slate near the bottom.

About 35′ below the Darlington is the smut of the Kittanning, with its immense bed of Fire Clay below. It was once opened here, and is reported to have been 3′ thick and quite a good coal, though much inferior to the Darlington.

On the Right Branch of Bennett's run coal is mined by Mr. Robinson, a short distance up the stream, and there we see the following section of 80′: (Fig. 177)

1. Massive Sandstone, Freeport, . .	25′
2. *Coal, local,* . .	4″
3. Shales, . .	2′
4 Coal, Darlington, . . .	2′ 9″
5. Fire Clay, coarse sandy, . .	2′
6. Sandy Shales, ...	35′
7. Coal, Kittanning, reported,	3′
8. Fire Clay, seen to bottom of creek,	10′

Here the Darlington coal has a parting near the top, and also a thin one near the bottom. The coal is very good.

The Freeport Sandstone forms a high cliff above the coal

The local coal, No. 2, is not seen at Mr. Dougherty's bank.

Three quarters of a mile above this we see the Lower Freeport coal at the road side 1′ thick, and the Butler Limestone 2′ thick below it. The coal is there 70′ above where the Darlington was last seen at Robinson's.

At the head of the run into the Beaver opposite Homewood station the Upper Freeport coal becomes of available thickness, and is mined on the land of Kennedy, Hazen, Freed, and others. The coal is there 450′ above the Beaver river at Homewood. At Mr. Freed's bank the coal is 4′

thick, and tolerably good, though it contains considerable pyrites. The coal was once mined extensively here by the Economite Society and taken on a tram road down the run to the Beaver and shipped on the old canal. There is a parting in the coal a few inches above the bottom.

A short distance north, at Mr. Kennedy's, we see the following in descending from the road to his coal bank: (Fig. 178)

1. Coal, Blossom, Brush Creek,	?
2. Concealed,	85′
3. Coal, Upper Freeport,	4′
4. Fire Clay,	3′
5. Limestone, Freeport,	4′

Here the blossom of the *Brush Creek coal* is seen in the New Castle road and may be either coal or a bituminous shale. Above it 10 or 12′ is seen a decomposed mass of what may have been the *Brush Creek Limestone.* It looks like a fire clay now, however.

The *Upper Freeport coal* is not now mined by Mr. Kennedy, and his bank is abandoned

The *Upper Freeport limestone* is quite hard and compact, and of the peculiar grayish color which this stratum nearly always possesses. It is also non-fossiliferous.

Mr. Hazen mines the coal a short distance north. Here it varies from 3½ to 4′ in thickness, and is a very fair coal.

The Mahoning Sandstone is seen in a massive stratum above it.

Descending this run to the Beaver, opposite Homewood Station, we see the immense Piedmont Sandstone finely exposed in a cliff 150 to 160 feet thick, and huge masses of the rock are scattered over the ground.

The remaining part of this township along the Beaver river and in the vicinity of old Homewood furnace was examined by Mr Chance, and will be reported on by him.*

Between the Connoquenessing and the Beaver river, is a large, high tongue of land which is capped by the Mahoning sandstone, and extends out nearly to where the Connoquenessing is joined by the Slippery Rock.

The Freeport Limestone is seen on this ridge, just north from the cross-roads at Mr. Irwine's, in layers separated by fire-clay It is probably eight to ten feet thick altogether, and is seen in the road.

---

* See the forthcoming reports on Lawrence and Mercer counties.

The Darlington Coal One mile north from here, and a short distance south from the school-house, the Darlington coal is mined for country supply on the land of Mr. Harris. It is 3' thick and quite good. It is 140' below the Freeport Limestone where last seen on the hill above. Mrs. Main, just east from here, also has a bank open.

Passing down to Hazen's bridge at the mill we find a coal mined by Mr. Joseph Hazen, 85' above the *Ferriferous Limestone*, which is here 23' thick, and *extends in a line of cliffs* around the hill. Opposite Hazen's bridge we see the following 192': (Fig. 179.)

1. Ferriferous Limestone,	20'
2. Concealed,	135'
3. Massive Sandstone, (part of Piedmont SS.),	15'
4. Concealed,	10'
5 Massive Sandstone to the level of the creek,	12'

Here the Ferriferous Limestone lies in huge blocks around the top of the bluff.

No. 3 is doubtless a part of the Piedmont Sandstone, as a small coal was seen at a point near here in the concealed interval below. It is quite massive, and has been quarried.

The *Mercer Limestone* should come in No. 4.

No. 5 is the upper part of the Connoquenessing Sandstone here, nearly all gone under the stream. It is very massive, and is a coarse, whitish, very hard stratum.

Connoquenessing Section.—Passing up around the bend of the Connoquenessing, the last part of the massive sandstone of No. XII soon passes under the stream, and one mile above the mill in descending a steep bluff to the creek we get the following long section of 324': (Fig. 180.)

1. Massive Sandstone, Freeport, seen,	35'
2. Concealed, (Darlington and Kittanning,)	100'
3. Sandy Shales,	15'
4. Limestone, Ferriferous, (in cliffs,)	22'
5. Sandy Shales,	30'
6. Coal, Clarion,	1' 6"
7. Fire Clay,	2'
8. Concealed,	10'

9. Fire Clay,	5′
10. Concealed,	7′
11. Flaggy Sandstone,	10′
12. Black Calcareous Slate,	1′
13. Fire Clay, non-plastic,	1′ 6″
14. Bluish Sandy Shales,	2′
15. Coal, (Brookville?)	8″
16. Black Slate,	4″
17. Fire Clay,	2′
18. Bluish Shales, containing Iron Ore,	5′
19. Drab Sandy Shales,	15′
20. Concealed,	10′
21. Coal,	6″
22. Flaggy Sandstone,	36′
23. Concealed to Connoquenessing creek,	5′

No. 1 is a very massive rock and large blocks of it are scattered over the hill. It is the Freeport Sandstone. The Darlington and Kittanning coals come in interval No 2, but this was entirely concealed, and nothing was seen of them.

The Ferriferous Limestone is here a very thick stratum, and forms a bold cliff around the hill half way up its side, from which huge masses *as large as a house* have broken away and rolled to the valley below. The limestone is *crowded with fossils*, and is the same kind of limestone, having the same lithological character, which we recognize whenever this bed is of unusual thickness

The Clarion coal is 1½ feet thick, but, except at the top where it is a little slaty, quite pure and good

No. 15 probably represents the Brookville coal.

Great Variations in the Measures Illustrated.

The section below the Ferriferous limestone so fully shown, is of especial interest in showing the rapid change in the character of important strata. At Homewood and along the Beaver, only 3 miles south-east from here this interval is occupied by an immense conglomeratic sandstone 160′ thick, without a break, while here we get no sandstone worthy of the name till near the bottom, and we find three small coals in the interval. Here the Ferriferous limestone is 144′ above the stream, while one mile below it was 172′, and as the creek falls 8′ in this distance, we have *a dip* of 20′ per mile *to the east* at this locality.

The Mercer limestone is not seen, and may be absent or else concealed in interval No. 20.

On the New Castle road, one mile from North Sewickley post office, *the Darlington coal* is mined on the land of Mr. Isaac Hazen, where it shows the following section: (Fig. 181.)

Darlington Coal,	1. Coal,	2′	2′ 7″
	2. Slate,	1″	
	3. Coal,	6″	

This coal is quite pure and good, and is very bright and lustrous. One half mile south-east from Hazen's the same coal is mined on the land of Mrs Collins and Mr. Jackson The structure is the same as that seen at Hazen's. The outcrop of the Darlington coal is seen in the road near the North Sewickley Academy, and descending along the road west to the little run below we see the following 130′: (Fig. 182)

1. Coal, Blossom, Darlington, (Upper Kittanning,)	(?)
2. Shales, Sandstone, and concealed,	40′
3. Coal, Blossom, Kittanning,	(?)
4. Fire Clay, seen,	6′
5. Concealed,	84′
6. Coal, Blossom, Clarion,	(?)

The blossom of the *Kittanning coal* is seen in the road near the church, while the Darlington is seen above it near the academy. The Kittanning makes quite a black streak in the road, and has below it a large bed of Fire Clay as usual It has not been opened in this neighborhood, and very few of the farmers are aware of its existence.

The Clarion coal bed, No. 6, also makes a large black streak in the road, and has been mined by stripping on the opposite side of the creek, where it is 18″ thick, but rather impure.

Passing up the Connoquenessing the strata dip rapidly to the south-east, and at the mouth of Brush creek the *Clarion coal* is at water level where it has been stripped out of the bed of the latter stream. It is here 20″ thick and quite pure. The Darlington coal comes 140′ above it, and the Mahoning Sandstone caps the highest hills.

The Darlington coal is opened on almost every farm, and varies from 28 to 36″ in thickness, always containing a parting of slate below the middle. It is highly prized as a domestic fuel, and is also used by the smiths of the neighborhood. It is mined by Messrs. Swick, Bonzo, Baxter, Boots, Blim, and others. At Mr. Blim's bank we see the following section of 100′: (Fig. 183)

1 Sandy Shales,			10′
2. Coal, Darlington,	1. Coal,	2′	2′ 6″
	2. Slate,	1″	
	3. Coal,	5″	
3. Fire Clay, seen,			2′
4 Concealed to Brush Creek,			85′

The top of the coal is a little slaty for a few inches, but the main body of the coal is very rich and good

The Darlington coal is mined by Mr. Newton, on a little stream which puts into Brush creek at Barrisville post office, and there we get the following 151′ in descending the hill (Fig 184.)

1. Massive Sandstone, Mahoning, seen,	20′
2. Coal, Upper Freeport,	2′ 6″
3. Fire Clay,	3′
4 Limestone, Freeport,	2′
5 Concealed,	120′
6. Coal, Darlington,	4′

The *Mahoning Sandstone* forms a bold line of cliffs along the hill, and *rests directly on the* underlying *coal*, which has here been opened by Mr. Ullery. It is 2½ feet thick at the mouth of the bank, but it soon runs down to only one foot, being cut away by the sandstone above. It contains much sulphur

The Freeport limestone is quite compact, and has been burned by Mr. Ullery, who reports it as making an excellent lime.

The Darlington a pure coal.

Only 3 rods below the mouth of the bank, we see it but 6 inches thick, with 3′ of black sandy slate above it, and, on tracing this bituminous slate to the mouth of the bank, it is seen to turn gradually into coal, and then we have a bed, 3 to 4′ thick, of very pure and brilliant coal It is mined here by Mr. Newton, who reports it as running out almost entirely when traced in some directions. It is the same coal which is mined by Mr. McDaniels, at the mouth of this stream. The upper part of this coal is a semi-cannel, and, as previously stated, the bituminous slate is seen actually changing into coal at the mouth of the bank.

Plant bed of shales under the Darlington Coal.

On the opposite side of the stream, only a few feet away, this coal is represented by a mere mass of bituminous shales, with no coal whatever. There is no Fire Clay under the coal here, but it rests immediately on a dark sandy shale, which is crowned with plants, of the same species which occur in a similar position under this coal at Cannelton.

Passing up to the head of this stream, we get the following, on the land of Mr. Graham, 94′: (Fig. 185.)

1. Coal, Brush Creek,	1 Cannel, Slaty,	1 ′
	2. Cannel, good,	4 ′
	3. Bituminous Coal,	1 ′
2. Concealed,		50 ′
3. Sandstone, massive, Mahoning,		30 ′
4. Coal, Upper Freeport,		2 ′
5. Fire Clay,		4 ′
6. Limestone, Freeport,		2½′

Here the *Brush Creek coal* was once opened by Mr. Graham, and was found to be a *cannel* coal of fair quality, resting on one foot of bituminous coal. The mine had to be abandoned, however, as the drift could only be made to the south, and could not be drained in that direction. The coal is seen in Mr. Graham's cellar, and, except near the top, is of tolerably fair quality, and is reported to burn very nicely into a white ash. Some pieces of it were seen which had lain on the dump for ten years, and they were not in the least decomposed, but as compact and firm as ever.

The Upper Freeport coal has also been opened by Mr. Graham. It is quite thin, however, and was not pursued.

At the head of Broad run, which puts into Brush creek above Mechanicsville, the Upper Freeport coal is mined on the land of Mr. Smith McDaniel, and there we see the following, in descending from the road to his bank, 100′: (Fig 186.)

1. Coal Blossom, Brush Creek,			2′
2. Concealed,			45′
3. Mahoning Sandstone, very massive,			40′
4. Coal, Upper Freeport,	1. Coal,	1′ 4″	1′ 8″
	2. Slate,	1″ to 2″	
	3. Coal,	2″ to 4″	

[illegible]

5. Fire Clay,	2′ 6″
6. Limestone, Freeport,	3′
7. Concealed to run,	5′

Here the *Brush Creek coal* is seen in a large band of smut, across the road above Mr. McDaniel's house

The Mahoning sandstone is very massive, forming perpendicular cliffs along the stream, and resting immediately upon the coal At the mouth of the bank the coal shows the section which I have given, but, further in the hill, Mr. McDaniel states that it thickens up to 28″, and is still getting thicker. The coal is bright and lustrous, but contains some pyrites.

Two and one half miles north-west from here, the Upper Freeport coal was once mined on the land of Mr Powell. It is reported to be 3′ thick. The Freeport limestone is seen below it, and 90′ above occurs the blossom of the Brush Creek coal.

36. Marion Township, Beaver County.

This small area lies directly east from North Sewickley, and north from New Sewickley.

The Connoquenessing forms its northern boundary, while Brush creek flows along just within its eastern border. All the rest of its streams are small, and rise in the highlands on its southern border, and pass with a rapid descent into the Connoquenessing.

The Darlington coal is of available thickness all along the Connoquenessing, and for a short distance up its tributaries

The Kittanning coal is also available along the lower half of the Connoquenessing, in this township, and for some distance up Brush creek.

The Upper Freeport is not found of workable thickness at any point within the township.

Just before Brush creek passes into North Sewickley township, the Kittanning coal was once mined on the left bank by Mr. Mercer, and there we get the following 103′: (Fig. 187.)

1. Massive Sandstone, Freeport, seen,	20′
2. Shales,	10′
3. Coal Blossom, Darlington,	(?)
4. Concealed,	45′

5. Coal, Kittanning,	2′
6. Fire Clay, seen,	6′
7. Concealed to level of Brush Creek, .	20′

Here the *Kittanning* coal is reported by Mr. Mercer, who has made two openings in it, as a coal of excellent quality, pure and free from sulphur, and prized by the smiths.

Under it lies the large bed of *Fire Clay* which so often occurs with this coal Six feet of it was seen, and Mr. Mercer says it is much thicker. It is very pure and white, and has in some cases been used as a white-wash by the farmers.

A half mile above here this coal passes under the creek

The *Darlington* has not been opened; but Mr Mercer showed me where he had ploughed it out in the field, and Mr. Blim has it opened at this horizon only a short distance below in North Sewickley township Passing up Brush creek we get no more openings in the Darlington coal until we come to Barrisville post office, and there it is mined by McDaniel, at whose drift we see the following 24′. (Fig 188.)

1. Sandy Shales,	10′
2 Cannel Slate,	2′
3 Coal, Darlington,	2′
4. Fire Clay, seen,	2′
5. Concealed to level of Brush Creek,	8′

Here the coal has been mined for a long time and is of excellent quality, being quite hard, brilliant, and clear, and free from pyrites. It has an excellent reputation in the neighboring country. It is roofed with 2½ feet of a very richly bituminous slate or impure *cannel.* This is the shale which is seen turning into a semi-cannel coal in North Sewickley township, a short distance up Newton's run from this point.

Not far above Barrisville, the Darlington coal passes under Brush creek and is seen no more.

Along the Connoquenessing there are numerous openings, and the coal is of nearly the same thickness and quality in all On the land of Mr. West, just below where the creek comes into Beaver county from Butler, there have been a great many openings made in this coal, and here we see the following: (Fig. 189)

1. Shales,			(?)
2. Coal, (Darlington,)	1. Coal,	1′ 8″	2′ 5″
	2. Slate,	1″	
	3. Coal,	6″	

The coal is of medium quality, though it contains more sulphur than usual. It is about 25′ above the Connoquenessing.

Near the mouth of Pine run it is mined by Mr. Ketterer, and there shows the same section which we see at West's, though the coal is purer and more free from sulphur at this locality

The same coal is also opened on the land of Mr. Hickey, ½ mile below.

37. *Franklin Township, Beaver County.*

This is in the north-east corner of the county, immediately north from Marion, and is bounded on the north by Lawrence county, and on the east by Butler county.

The Connoquennessing creek forms its entire southern and western boundary. Camp run passes through it from Lawrence county, and, with this exception, all its other streams are small, rising within the township, and flowing south to the Connoquennessing.

Opposite North Sewickley we get the following section, in descending along the road past Mr. Wilson's from Stamm's coal bank 237½′. (Fig. 190.)

1. Sandy Shales,	10′
2. *Coal*, Darlington,	2′
3. Concealed,	95′
4. Limestone, Ferriferous,	15′
5. Sandy Shales,	20′
6. Bituminous Shale,	6″
7 Shales and Sandstone,	10′
8 *Coal Blossom*, Clarion.	
9 Concealed,	65′
10 *Coal* and Black Shale,	2′
11. Fire Clay,	3′
12 Concealed to level of the Connoquenessing,	15′

Here the Darlington coal was once mined on the land of Mr. Stamm, but the mine is not now in operation. It is reported to have been 2 feet thick and a very fair coal.

The Ferriferous Limestone is seen in a huge bed, near Mr. Wilson's, and is filled with organic remains.

No. 8 probably represents the Clarion coal, and No. 10 the Brookville.

At the head of the first little stream which puts into the Connoquenessing above Cunningham's bridge, the *Darlington coal* is mined, on the land of Mr. McQuiston, and descending from this point to the creek we see the following section of 202′: (Fig. 191.)

1. Sandy Shales,	10′
2 *Coal*, Darlington,	1′ 8″
3. Concealed,	95′
4. Ferriferous Limestone,	8′
5. Sandy Shales,	12′
6. Sandstone,	6′
7. *Coal*, impure,	6″
8. Fire Clay,	2′
9. Sandy Shales,	12′
10. *Coal*, Clarion,	1′ 6″
11. Fire Clay,	8′
12. Shales,	2′
13. Sandstone,	4′
14. Argillaceous Shales,	6′
15. Blossom of Coal,	?
16. Shales and Fire Clay,	6′
17. Concealed,	10′
18. *Coal*,	1′
19. Fire Clay, non-plastic,	1′
20. Concealed to level of the Connoquenessing,	25′

The Darlington coal is here mined on a small scale. It is thin, however, being only 20 inches thick at the mouth of the drift, but thickening up to 26 inches further in the hill, as I was informed by Mr. McQuiston. It is a very fair coal, being almost free from pyrites, and of a shining, *pitchy* luster. It is reputed an excellent smithing coal. The interval between the Darlington coal and the Ferriferous Limestone is entirely concealed, and nothing can be seen of the Kittanning coal.

The Ferriferous Limestone has thinned away in ½ mile from 15 feet to only 3, and it is quite impure at that, containing much cherty matter in its lower part. It was once burned near its outcrop here on the little run. It is full of its characteristic fossils. Only a short distance up the stream from this point the Ferriferous Limestone *thins away altogether*.

The Clarion coal, No. 10, has been mined by stripping along the streams It is a tolerably good coal, and though somewhat slaty at the top makes an excellent fuel

Coal No 18 has also been stripped along the stream, but is somewhat slaty and impure.

The Clarion coal. A short distance below the mouth of Brush creek, No. 10 of the section has been drifted on by Mr. Nye, and also stripped out of the run there. It is reported as 2 feet thick and quite good. Just above the mouth of Brush creek it passes under the Connoquenessing

One and a fourth miles above the mouth of Brush creek Soap run puts into the Connoquenessing from the north, and at its head, 2 miles from the creek, some high knobs catch a few *outlying* patches of the *Upper Freeport* coal. No banks were in operation when I visited the locality. but the coal has been mined on the land of Messrs. Koch, Engle, and Doutt. The coal is 4 feet thick, but contains considerable sulphur, and cannot be used for smithing purposes.

A very massive and conglomeratic sandstone is seen above the horizon of the coal, and descending the run from Doutt's bank we get the following section of 289′: (Fig. 192.)

1. Massive Sandstone,	(Mahoning)	20′
2. Shales,		5′
3. *Coal*,		4′
4. Concealed,		60′
5. Sandstone,		15′
6. Sandy Shales and concealed,		20′
7. Black Slate,		4″
8. *Coal*, Lower Freeport,		8″
9. Fire Clay and Shales,		4′
10. *Limestone*, Butler,	(Lower Freeport)	3′ 6″
11. Concealed, with occasional exposures of Sandstone and Shales,		60′
12. *Coal*, Darlington,		2′
13. Concealed,		50′
14. Blue Sandy Shales,		40′
15. Concealed to the level of the Connoquenessing,		5′

Here No. 1 is seen covering the ground in immense masses, one fourth mile south from Mr. Doutt's opening in the Upper Freeport coal It is very coarse, and contains some pebbles.

No. 10 is the limestone which is occasionally found under the Lower Freeport coal, and is what I have termed the *Butler Limestone* It is quite ferruginous, being filled with small nodules of iron ore. It was once burned for lime at this locality.

The *Darlington coal* is mined at the forks of Soap Run by Mr. Swick, where it is 22″ thick, and tolerably good Mr John Musser also mines it one fourth mile above the mouth of this little run, where it is 95 feet above the level of the Connoquenessing, and there we catch sight of the Kittanning coal below, which Mr. Musser once opened. He says it is 18 inches thick, and is known in this neighborhood as the "18-inch vein" It comes 35 feet below the Darlington coal.

The *Kittanning Fire Clay*, in an immense bed, is seen just below where Mr. Musser says he opened the coal.

Soap Run long Leveled Section.

One half mile above the mouth of Soap run, a little stream tumbles down the steep bluff, and exposes the following fine section of 283½′: (Fig. 193.)

1. Coarse massive Sandstone to hill top, (	)	15′
2. Drab Sandy Shales,		4′
3. Concealed,		18′
4 Sandy Shales,		15′
5. Sandstone,		5′
6. Sandy Shales,		15′
7. Massive Sandstone,	(Upper Freeport SS?)	15′
8. Dark Sandy Shales,		17′
9. Concealed,		11′
10. Sandy Shales,		20′
11. *Coal*, Lower Freeport,		1′
12. Dark Sandy Shales,		4′ 6″
13. Massive Sandstone, Freeport,	(Lower Free. SS.)	30′
14 Sandy Shales,		20′
15. *Coal*, Darlington,	(Upper Kittanning)	2′ 4″
16. Fire Clay, Sandy,		5′
17. Sandy Shales,		40′
18. Coal, Kittanning,	(Lower Kittanning)	1′ 8″
19. Concealed,		10′
20. Sandstone,		4′
21. Sandy Shales,		20′
22. Sandy Shales, containing Iron Ore, to the creek,		10′

This section was very carefully made with hand-level, and it exhibits a succession in its upper numbers which is quite perplexing. The *Sandstone at the top* of the section is very massive and conglomeratic, and is not all seen here, as the top of it has been eroded It forms a perpendicular *cliff* around the summit of the hill, and comes at the same horizon as the massive sandstone seen above the 4 feet bed of coal in the previous section. But no coal is seen here, and, if any exists, it is a very small bed in No. 3, which is concealed, and the slope is so steep that if any coal were present, it would be shown in a blossom.

No. 7 is also a very massive rock, and extends around the hill in a bold, massive cliff. This, with Nos. 5 and 6, may represent the Mahoning Sandstone, while No. 1 may be the Buffalo Sandstone, and then the coal seen below it in the preceding section would be the Brush Creek.

The upper part of No. 11 is very slaty, and the limestone is absent, being replaced by a dark, sandy stratum, containing fossil plants, in which were seen *Neuropteris rari nervis*, *N. Loschii*, *Alethopteris sp?*, *Cordaites borassifolius*, and others.

The Freeport Sandstone is quite massive, too, and is seen forming a line of over-hanging cliffs along the hill.

The Darlington coal is exposed, and is seen to be divided midway by a parting of slate, one half inch thick. It is a very fair coal, where exposed in the ravine

The Kittanning coal has here been worked out along the road, both by drifting and stripping. It is called the "18-inch vein" by the farmers, who say it is better and purer than the Darlington above it. The coal is very rich and oily, and is in high repute.

The Kittanning Fire clay.

A short distance above the line of section, the concealed interval below it is seen to be occupied by a huge bed of very pure-looking Fire Clay.

This coal is mined by Mr. Fumbell, ¼ mile below the mouth of Camp Run, where it is 2 feet thick, and very pure, having the appearance of a *block* coal, but being more pitchy. At the mouth of Camp run it is 7 feet above that stream, and the great bed of Fire Clay below it is seen ex tending below the bed of the creek. The coal has bee mined all along Camp run, both by drifting and stripping the Darlington coal above being comparatively neglected though an old opening is seen in it on the right bank o Camp run, 50 feet above the Kittanning coal.

A few rods above the mouth of Camp run the Kittannin coal passes under the Connoquenessing and is seen no more

One half mile above the mouth of Camp run, The *Dar lington coal* is mined by Mr. Stamm, where it is 22 inche thick and 40 feet above the Connoquenessing.

Two miles above the mouth of Camp run we get the fol lowing section, in descending a ravine on the land of Mr Metz 161′: (Fig. 194.)

1.	Shaly Sandstone, and concealed,		20′
2.	*Coal*, Upper Freeport,		1′
3.	Fire Clay,		8′
4.	Limestone, Freeport,	(Upper Freeport L.)	1′
5.	Sandy Shales and Sandstone,	(U. F. Sandstone)	58′
6.	*Coal*, Lower Freeport,		1′
7.	Fire Clay,		8′
8.	Limestone, Butler,	(Lower Freeport L.)	4′
9.	Fire Clay and Sandy Shales,		6′
10.	Freeport Sandstone,	(L. F. Sandstone)	35′
11	Sandy Shales,		25′
12.	*Coal*, Darlington,	(Upper Kittanning)	2′
13.	Fire Clay, Sandy,		5′
14.	Sandy Shales and Sandstone to the level of the Connoquenessing,		25′

The Upper Freeport coal was once mined here, but I could learn nothing of its thickness. I saw only one foot of it, and I think it can hardly be more than 2½ feet thick

The Freeport Limestone is of a light gray color, and quite compact and hard.

The Lower Freeport coal has also been stripped out of the run by Mr. Metz. It is somewhat slaty, however, and makes much ash in burning.

The Butler Limestone here makes its appearance again, and is very much the same kind of a rock that we saw it on Soap run, being quite ferruginous and filled with *iron nodules*, having a gray cast on fresh fracture, but weathering buff. It breaks with a sharp, clear fracture.

The Darlington coal is mined by Mr. Metz, and is very good

At the mouth of Door run, near the Butler county line, the creek has made a big bend to the north, and the Darlington coal is thrown 50 feet above it. Below the coal we get a vast quantity of *iron ore* in nodules between the Darlington coal and the Kittanning. Here at the mouth of Door run was once a *charcoal furnace* which used this ore below the coal. The furnace ceased to operate about 50 years ago, though a large quantity of iron was made in early times (This corresponds to the Johnstown Cement Bed of the Report HHH.)

38. Big Beaver Township, Beaver County.

This lies immediately west from North Sewickley and adjoins Lawrence county

No streams of any consequence pass through it. The Big Beaver flows along its eastern border, and the North Fork of Little Beaver flows along its western margin, while small streams rise in the highlands and pass into either stream.

The column of rocks in this township extends from the Brush Creek coal far down into the Conglomerate series, or Beaver River Group, making a section of about 600 feet.

The Darlington coal bed mistaken for the Kittanning.

The Darlington coal has been mined extensively in this township, in the vicinity of Clinton, and below that along the Beaver. This was formerly considered the Kittanning coal, but it is not, as that coal has thinned away to 18 inches in coming up the Beaver, and is found 30 feet below the coal worked at Clinton, with the great bed of the true *Kittanning Fire Clay* below it

Mr. Chance will report on the coal around and below Clinton, so that nothing more need be said of it here except to give the structure which the Darlington coal shows at these banks, which is something like the following: (Fig 195)

1 Coal,	Darlington=U. Kitt. C.	2′ 6″	3′
2. Slate,		1″	
3 Coal,		5″	

Sometimes there is a thin parting one foot from the top. The coal is of excellent quality. No mines are in operation now on this coal along the Big Beaver at any of the extensive coal-works, all having closed work for the present.

The Clark's Run Long Section.

Clark's run puts into the Big Beaver at Homewood Station, and at its head the Pittsburg, Fort Wayne and Chicago railroad passes across the summit between the two Beavers, through a deep cut, which makes a fine exposure of the measures, and descending from the hill above to the railroad and along the track down Clark's run we got the following section of 564 feet. (Fig. 196.)

1.	*Coal* Blossom, Brush Creek. (Gallitzin.)		
2.	Fire Clay,		8'
3	*Limestone*,		5'
4.	Concealed,		50'
5.	Fire Clay,		2' to 10'
6	*Limestone, Freeport*, in several layers, with Shales and Clay interstratified,		10'
7.	Shaly Sandstone,		15'
8.	Dark Shales,		20'
9.	Bituminous Slate,		10'
10.	*Coal, Lower Freeport*,		1'
11.	Fire Clay,		6'
12.	*Limestone, Butler*,	1. Limestone, 1' 6'' 2. Shale, 2' 3. Limestone, 2'	5' 6''
13.	Fire Clay and Sandy Shales to the level of the R. R. at summit, 1,055 feet above tide,		8'
14.	Passing along the R. R. east, the descent is very rapid, and we see Sandy Shales and Sandstone,		65'
15.	*Coal, Darlington*,		1' 6''
16.	Shales,		25'
17.	*Coal, Kittanning*,		2'
18.	Passing from this point to Homewood, and continuing the section down to the Beaver from an old opening in the Kittanning Coal, we get · Concealed,		78'
19.	Massive Conglomeratic Sandstone, Piedmont,		155'
20.	*Streak of Coal.*		
21.	Bluish Shales, containing Iron Ore,		15'
22.	Dark Sandy Shales,		45'
23.	*Coal, Semi-Cannel*,		6''
24.	Fire Clay and Sandy Shales,		5'
25.	Calcareous Iron Ore,		2'
26.	Blackish Sandy Shales,		18'
27.	Hard white massive Sandstone to the level of Big Beaver,		18' 6''

Limestone under the Brush Creek Coal.

Here we get a limestone under the Brush Creek coal. At this locality it is seen only in a line of boulders, but a short distance north it is seen well exposed at the roadside, where it is 5—6 feet thick. It is a light-colored, compact rock, and breaks with a sharp, clear fracture. It has a tendency to come out in thin slabs like a flag-stone, and its cavities are filled with calcite. The coal above it makes quite a large blossom in the road.

The Upper Freeport coal should come above No 5, but it is entirely *absent* here.

The *Upper Freeport fire clay* is mined and manufactured into fire-brick by Keir & Bros., of Pittsburg. It varies from 2 to 10 feet in thickness, at times being replaced with limestone and iron ore. It makes an excellent quality of fire-brick and furnace lining, as is testified to by the iron men who have used them

The Freeport Limestone is seen in five or six layers separated by fire-clay or shales. Some parts of the limestone are very ferruginous and could be used for an iron ore. It is seen in the top of the summit cut.

The Lower Freeport coal, with its overlying bituminous shales is seen in the summit cut. The coal is very pure and clean looking, and has no tendency to break up.

The Butler Limestone is likewise seen in the summit cut, and is in two layers separated by shales; both are quite ferruginous and brecciated. At the highest point on the railroad in the cut this limestone comes within eight feet of the track Descending the track toward Homewood we see nothing but shales and sandstone until the Darlington and Kittanning coals have come up three quarters of a mile east on the land of Mr. McCready. In this interval we descend 65 feet.

The blossom of the *Darlington coal* is seen in the bluff along the railroad, and (25 feet below it) comes the Kittanning, which is 22 inches thick, with a small parting of slate five inches below the top. It is here a few feet below the level of the track and has been stripped out of the bottom along side the railroad, and on the opposite side of the run has been mined by drifting on the land of Mr. McCready.

The thickness of the *Darlington coal* was not seen here, but three fourths of a mile below; it is mined on the land of Mr. Johnston, where it is 90 feet above the railroad, and shows the following section: (Fig. 197.)

1 Coal,	Darlington,	1′ 2″	1′ 9″
2 Slate,		1″	
3. Coal,		4″	
4. Slate,		½″	
5. Coal,		1½″	

At this locality it is near the top of the hill and is coated with a film of oxide of iron, which gives it a rusty color. It is very good, however, except the bottom, which is slaty

At Homewood, the Kittanning coal was once mined but is now abandoned. It was reported two feet thick

The Piedmont Sandstone locally deposited.

Here, at Homewood Station, the run passes over the massive Piedmont Sandstone with a perpendicular fall of 30 feet, and its course below is a series of *falls and cascades*, rendering the scenery along its course wild and picturesque in the extreme. This immense mass of sandstone is a coarse, yellowish white rock, and some of it conglomeratic. Its top extends above the horizon of the Ferriferous Limestone, which it has cut out entirely. It was probably a beach line or sand bank in the ancient sea; for it rapidly thins away when traced north from here, and only three miles north-east we find its place occupied by nothing but shales and two or three small coal beds.

Mount Savage Coal Bed represented?

At its base is seen a small streak of coal two to three inches thick, which, one mile above, thickens up to a bed of workable size, and is mined on the land of Mr. Beaty, where the coal is 2½ feet thick and quite good.

The bluish shales under this rock contain a considerable quantity of nodular *iron ore*, drifted on at one time to supply the old Homewood furnace.

The little coal, No. 23, is a kind of semi-cannel.

The calcareous stratum, No. 25, is an impure *iron ore*.

The Pottsville Conglomerate, No XII

The massive white sandstone, No 27, is seen rising rapidly from the river here, very hard and tolerably fine-grained. As we ascend the Beaver it rises quite rapidly and soon cuts the 80 feet of slate here intervening between it and the Piedmont down to only 20 feet. At the mouth of the Connoquenessing its top is 110 feet above the Beaver This is the upper wall rock all the way along the Connoquenessing to the mouth of Slippery Rock

Limestone under the Brush Creek coal

One mile north from the summit cut the limestone under the Brush Creek coal is seen near the cross-roads, on the land of Mr Scott. It there forms a massive ledge along the road, and is about eight feet thick It shelves off in large flaggy layers, and is an ashen-gray rock, containing much calcite in cavities.

One mile north from this, on the land of Mr Marion Marshall, we see the following section of 79′: (Fig 198)

1. *Coal Blossom*, Brush Creek.			
2. Fire Clay and Shales,			4′
3. *Limestone*,			6′
4. Concealed,			60′
5. *Coal*, Upper Freeport,	1 Coal,	3′ 6″	4′ 4″
	2 Slate,	2″	
	3 Coal,	8″	
6. Fire Clay,			2′
7. *Limestone*, Freeport, seen,			8′

The Brush Creek coal is seen in the road near the top of the ridge. It makes quite a large blossom, and must be 3 feet thick at least, but it is too near the surface here to mine.

The limestone is seen below the coal along the road, at the same level which it occurs on Mr. Scott's land, one mile south. It has the same shelving, slaty appearance previously noted

Mr Marshall mines the Upper Freeport coal at this locality, and says that it varies in thickness from 3 to 6 feet. The bottom coal is somewhat slaty and impure, as is also 6 inches of the top, but the rest of the upper bench is a very fair coal

The (Upper) Freeport limestone is hard and compact, slightly ferruginous and brecciated. It is on the same level that we find it in the top of the Summit cut, two miles south, showing that the dip has been flattened, or even reversed by the *Fredericktown Axis.*

The Northern Drift

All the highlands of this township contain more or less metamorphic boulders scattered about on the surface, which vary in size from one half foot in diameter up to 3 feet. They are found on the summits of the highest hills, and have been seen 1,300 feet above tide.

The Jordan's Run Section.

Jordan's run puts into the Little Beaver near New Galilee, and a short distance up the stream we see the following, in descending a steep hill to the run, 234′: (Fig 199.)

1. Fire Clay,		4′
2. Sandy Shales,		12′
3 Massive Sandstone, Mahoning,		40′
4. Concealed,		5′
5. *Limestone*, Freeport,		4′
6. Concealed,.		45′
7. *Coal*, Lower Freeport,		2′ 8″
8. Concealed and Sandstone,		80′
9. *Coal*, Darlington,	(Upper Kittanning)	2′
10. Fire Clay,		5′
11. Shales,		25′
12. *Coal*, Kittanning,		1′ 8″
13. Fire Clay, seen to bed of creek,		8′

The Brush creek coal should come in a few feet above the top of this section.

The Mahoning Sandstone is a very massive rock, and is seen along the hill in a perpendicular cliff. It is quarried on the land of Mr. McClure, where it is a very superior building stone.

A drift was once made at the horizon of No. 4 for the Upper Freeport coal, but it was found to be only a few inches thick.

The Freeport Limestone is very ferruginous and brecciated. Huge masses of it are scattered over the hillside, having slid out of their bed. It is here 180 feet above the level of the railroad track at New Galilee, which makes it 1,058+180=1,188 feet above tide.

The Lower Freeport coal was once mined, but the old drift is now abandoned, and the coal cannot be seen. It is reported, however, as being 32 inches thick, and a tolerably fair coal, but making a large amount of ash. It was also once mined on the opposite side of the run.

The *Darlington* or Upper Kittanning coal bed, No 9, is mined here by Mr. Patterson, where it shows the following structure: (Fig. 200.)

1. Coal,	1′ 7″	2′
2. Slate,	1″ to 2″	
3. Coal,	4″	

This is an excellent coal, being very pure, and entirely free from pyrites, so far as the eye can determine. It is rich, oily, and shining black. The bottom coal is not so good as the top.

The Kittanning coal is stripped out of the little bottom, on the land of Mr. Young. It is a very good coal, though only 20 inches thick.

The Terrace Gravel-Bed.

One and a half miles south-east from New Galilee, at the north side of the Pittsburg, Ft. Wayne and Chicago railroad, occurs what is termed the "Gravel-bed." It is a terrace deposit of rounded and angular rocks of almost every description, commingled with sand, lumps of coal, etc. It has been used for ballast for a long time on the railroad, and the slope now rises in almost a perpendicular cliff, for 60 feet; thus exposing the structure quite well. The base of it is here 25 feet above the railroad at New Galilee. This is only a remnant of what once spread clear across the valley of the Little Beaver, but has now been almost entirely removed by erosion. Small boulders of granite, gneiss, limestone, conglomerate, sandstone, quartz, &c, are seen in the gravel bed, and these are interstratified in places with beds of fine sand.

On the left bank of the Little Beaver, one and a fourth miles below New Galilee, we see the following section, in descending a steep bluff, 243′: (Fig. 201.)

1. Concealed, but covered with massive blocks of the Mahoning Sandstone,	30′
2. *Limestone*, Freeport,	3′ 6″
3 Concealed,	50′
4. *Coal*, Lower Freeport, Blossom,	

5. Sandy Shales, Flaggy Sandstone, and concealed,	87′
6. *Coal*, Darlington,.	?
7. Concealed,	25′
8. *Coal*, Kittanning,	?
9 Concealed to level of Little Beaver,	18′

Here the concealed interval, No. 1, is covered with immense masses of a coarse conglomeratic sandstone, some of which are doubtless in place.

The Freeport Limestone is seen extending around the point in a massive ledge. Both the Darlington and Kittanning coals have once been mined here, but the drifts have long been abandoned, and nothing could be learned of their thickness or quality.

The Freeport Sandstone, No. 5, is not at all massive, but consists of thin layers of sandstone, interstratified with shales.

Between the summit cut and Wallace's Run, along the Beaver Falls road, the *Upper Freeport coal* was once mined on the land of Mr. Stickle, where it is reported to have been 4 feet thick, but rather impure, containing much slate and sulphur.

At the mouth of Wallace's Run, the *Piedmont Sandstone* is seen in an immense cliff. It extends up to the level of the railroad, and the run has cut down through it a deep and narrow gorge. The railroad formerly crossed this gorge on a high trestle bridge, but subsequently the stream was arched over and a "fill" was made.

In the cuttings, on either side, was found a greasy aluminous clay covering the top of the terrace here, and this was tumbled into the fill with the rest, and with the most disastrous consequences; for a stratum of this, coming near the bottom, the whole mass above commenced creeping slowly off and slid away, and the mischievous clay had to be dug out and replaced with stone before the sliding stopped.

Between Wallace's run and Homewood, there have been several openings in the Kittanning coal, but none are now in operation.

39. Darlington Township, Beaver County.

This lies immediately west from Big Beaver township, and extends to the Ohio line for its western boundary.

The North Fork of the Little Beaver flows along its eastern border, and also forms its southern boundary all the way to the Ohio State line.

The Darlington Section of 232½ feet.

At Darlington, in the hill north-west from the town, we get the following section in descending to the Little Beaver: (Fig. 202.)

1. Massive Sandstone, Mahoning, seen,	10′
2. *Coal*, Upper Freeport,	0′ to 2′
3. Fire Clay,	1′
4. *Limestone*, Freeport,	3′
5 Concealed,	50′
6. *Coal*, Lower Freeport, impure,	2′ to 3′
7. Concealed,	10′
8. Sandstone, Freeport,	75′
9. Sandy Shales,	5′
10. *Coal*, Darlington,	1′ 6″
11 Shales, containing Iron Ore,	20′
12. *Coal*, Kittanning,	2′
13 Fire Clay,	10′ to 15′
14. Concealed to level of Little Beaver, at Darlington,	35′

The Mahoning Sandstone, No 1, caps the hill top, and has been extensively eroded; what is left of it is very massive, and *rests immediately upon the underlying coal*, which was here opened by Mr. Martin, but the thickness was so variable that it was abandoned Mr. Martin says that at times he would have 2½ feet of good coal, and within a few feet the sandstone would come down and cut it out almost entirely.

The limestone below it is in a single layer, of a light-gray color and very compact, breaking with a sharp, angular fracture. It was once burned for lime.

The Lower Freeport coal has also been opened by Mr. Martin, who reports it as 2 to 3 feet thick, but quite impure, containing much sulphur and slate, and being worthless as a fuel.

The *Freeport Sandstone* is finely exposed in a quarry. The upper 30 feet of it is somewhat flaggy and shaly, but the lower part is quite massive. It is a very hard, micaceous rock, and is a very indifferent building stone. About 45 feet above the base of the bed is seen the very hard, blue silicious layer, which was noted in Southern Beaver last year. (See Report K , page 343.)

The little coal, No. 10, is what I have termed the Darlington coal It is only 1½ feet thick, and a bituminous coal, but 3 miles below it becomes the great bed of cannel coal which has long been known as the Darlington cannel. The bed has been mined here in some instances, and is quite pure and highly prized for smithing purposes.

The Kittanning coal is mined by Mr. Martin. It is never more than 2 feet thick, and usually about 22 inches. It is pitchy black and shining, and is an excellent coal for domestic purposes, containing very little visible pyrites.

The Fire Clay under the coal is of immense proportions, 10 feet of it was seen, and Mr. Martin says it is much thicker. It is of an excellent quality, and was formerly manufactured into fire-brick in this vicinity.

The concealed portion is a mass of boulders and terrace deposits down to the Little Beaver.

Sharon Coal bed probably absent on Little Beaver.

Several wells have been bored along the valley in search of the Block or Sharon coal. They commence, usually, about 30 to 40 feet below the Kittanning, and come to a coal at a depth of 130 feet, which is only 2 feet thick, and is supposed to represent the Sharon coal. This, however, is not the Sharon, but the Lower Porter coal of Pennsylvania, which lies 160 feet above the Sharon. Some of the wells were bored deeper, but no coal of any consequence was found below the first one struck, so that there is probably no Sharon coal here.

Passing down the Little Beaver from Darlington, we see where numerous openings have been made on the Darlington coal and the Kittanning, but none of them are now in operation, as both coals are quite thin along this line.

The Coal Run Darlington Section of 287½ feet.

Three miles below Darlington we come to Coal run, and on this stream occurs the great bed of cannel coal, which has long been known as the Darlington cannel.

The section of 287½′ here given is principally the record of a boring made by Mr. Mansfield, commencing on the summit of the hill and passing down through all the strata: (Fig 203.)

1. Surface Clay and debris,	8 ′
2 Massive Sandstone,	12 ′
3. *Supposed place of* bed of Coal, (*3 Foot Vein*)	3 ′
4 Sandy Shales,	37 ′
5. *Coal*, Upper Freeport,	4 ′
6. Fire Clay,	2 ′ 4″
7. *Limestone*, Freeport,	1 ′ 8″
8. Gray and Brown Sandy Shales and Sandstone,	58 ′ 6′
9. Bituminous Shale, containing *streaks of Coal*, Lower Freeport,	3 ′
10. Very massive Sandstone, Freeport,	62 ′ 6″
11. *Coal*, Darlington, 1 Cannel Slate, 0′ to 6 ′ 2. Cannel Coal, 0′ to 12 ′ 3 Bituminous Coal, 0′ to 8½′	0′ to 21′ 6″
12. Dark Sandy Shales, containing fossil plants,	4 ′
13. Dark Sandy Shales, containing layers and nodules of Iron Ore,	25 ′
14 *Coal*, Kittanning,	2 ′
15. Fire Clay, seen,	5 ′
16. Concealed to level of the Little Beaver,	38 ′

This very complete section was obtained by combining observations made at the exposures with the record of the boring furnished by Mr Mansfield.

The Three Foot Vein (*Brush Creek coal bed?*)

No coal was passed through at the horizon of No. 3, but Mr. Mansfield thinks that is the place where the "three-foot vein" should come, and has so placed it in his boring. This is probably too low, however, and it likely comes above No. 2, as I have never seen it at less than fifty feet above the Upper Freeport, and have seen it frequently at twice that distance.

The *Upper Freeport coal* has been largely mined here by Henrici & Baker, of the Economy Society. A branch railroad was built by the Economites from New Galilee to this point, and this coal was extensively mined and shipped for a gas coal. But about the year 1863, the coal in this bed was exhausted, or rather all the workable coal was taken out of it, and the mines have not been in operation since that time.

The workable portion of the bed varied in thickness from 3½ to 4½ feet, and is said to have been an excellent coal. There being no banks in operation on it now I did not get to see the coal, except at the mouth of the old drifts.

No. 9 represents the *Lower Freeport coal*, and a company once drifted into the hill several yards at this horizon thinking it would turn into cannel. It is quite bituminous, and at times contains streaks of coal.

The *Freeport Sandstone* is very massive and is frequently seen cropping out in the ravines. It is a very hard, silicious rock.

The Darlington Cannel and Coal Bed.

Immediately below the F. SS. comes the great bed of cannel, which, at different localities here, exhibits the variations given in the section. This extensive bed of cannel coal is a *mere local deposit*, and has never been found off of the Mansfield tract in this township. The entire area is now owned by Mansfield & Co. The coal is usually separated into three distinct parts; first, at the bottom, we have one half to one foot of bituminous *coal;* then comes the *cannel*, resting immediately on it, and extending upward from six to twelve feet; gradually passing into the *cannel shale* above, which is sometimes as much as six feet in thickness.

The bituminous coal is very pitchy, and the bituminous layers are interlaminated with streaks of cannel At the upper mine, where the cannel has thinned away, this bituminous portion becomes 2½ to 3½ feet thick, and is extensively mined by Mr. Mansfield, and shipped as a gas coal, under the name of "Beaver Block Coal."

The cannel coal is of very fair quality at times, but it contains quite a large per cent. of ash, especially near the top, where too much of the roof has been taken out. It makes a bright cheerful fire, however, and burns up into a fine white ash. It is extensively mined by Mr. Mansfield, and shipped to Cleveland as a gas coal. In its thickest parts Mr. Mansfield informs me that twelve feet of good cannel has been mined. Its average thickness, however, is about seven feet. It graduates imperceptibly into the cannel slate, or rich bituminous shale above.

This shale was formerly distilled for oil on a large scale. The shale was preferred to the coal, as it made quite as much oil, and did not leave so much tarry products behind in the retort. One ton of shale made a barrel of oil. The discovery of petroleum of course put an end to the manufacture of oil, yet the company found it profitable to continue the manufacture of a heavy lubricating oil up to the year 1872, when the establishment burned down and was abandoned.

The whole bed exhibits the most remarkable variations. When approaching the margin of the deposit, frequently, the sandstone roof above comes down, and the bottom shales rise, and the two come together and *cut the coal entirely away.* I have seen six feet of coal at one point, and the whole mass would be thus cut out in going a distance of only fifty feet.

The Darlington Under-shale plant bed.

There is no fire-clay under this coal, but it rests immedidiately upon a dark sandy shale, which is literally filled with fossil plants, most of which are in a very good state of preservation.

In the cannel coal are frequently found stems of *Lepidodendron* and *Ulodendron*, which are much macerated.

The fine collection of fossil plants which Mr. I. F Mansfield has made at this locality, and generously presented to the Survey, has been alluded to in another portion of this report.

The *Kittanning coal*, with its underlying Fire Clay, is seen in a cut along the railroad, immediately below where the cannel coal has been mined. Mr. Mansfiield states that it is 2 feet thick.

The central portion of this township contains quite a large area of the *Upper Freeport coal* Near the head of Dillworth's run, it was once extensively mined by the Syracuse Coal Company, represented by Mr. Butts. Nothing has been done at the mines, however, for two years The coal was 4 feet thick, and when the mines were in operation one hundred tons were shipped daily to Cleveland as a gas coal. The available coal is nearly exhausted.

The Brush Creek (?) *Three Foot Coal.*

Sixty-five feet above the Upper Freeport, at this locality, occurs another coal, which was also mined to some extent, but it comes so near the surface that the roof could not be kept up. It is reported to have been 3 feet thick, and a very fine coal. This is very probably the Brush Creek coal, at least we shall call it that hereafter, although the identification is not certain.

A short distance above this, on the State road, the *Upper Freeport coal* is mined for country supply, by Mr. Laferty, and there we get the following: (Fig 204.)

1 Sandy Shales,			5'
2. Coal, Upper Freeport,	1. Slaty Coal,	6''	4' 2''
	2. Coal,	3' 3''	
	3. Slate,	1''	
	4. Coal,	4''	

It is a very fair coal, being pitchy, lustrous, and firm Very little pyrites were seen in it. The bottom coal is rather impure.

Passing on out the State road, we find the *Brush Creek coal* mined near the head of Coal run Here are two banks. One at the roadside, operated by Mr. Williams, shows 2½ feet of solid, pure coal, which exhibits scarcely any pyrites Some parts of the bed contain red coal, as it occurs very close to the surface It is in high repute among the farmers, and is said to be an excellent smithing coal

Mr. Clark has the other bank, on the opposite side of the run, and it shows the same section.

Near the State line, and one mile south from the Pittsburg, Fort Wayne and Chicago railroad, the Brush creek coal is mined on the land of Mr. Hartshorn, and there we get the following section of 71': (Fig. 205.)

1. *Coal*, Brush Creek,			2' 6''
2. Concealed,			60'
3. *Coal*, Upper Freeport,	1. Coal,	3'	3' 7'
	2. Slate,	1''	
	3. Coal,	6''	

4. Fire Clay,	2′
5. *Limestone*, Freeport, seen in bed of run, .	3′

The Brush Creek coal is mined at the roadside by Mr. Hartshorn It is a beautiful coal, coming out in rectangular blocks, and consisting of alternate layers of mineral charcoal, and pitchy, black bitumen, this giving it the appearance of a *block* coal It is quite free from pyrites

This same coal is also mined just below by Mr William Whan, where it is a little thicker than at Hartshorn's, as it sometimes attains 3 feet there

The Upper Freeport Coal bed and mines.

The Upper Freeport coal is exposed at the entry of the State Line Coal Company, on the land of Mr. Whan. Their entry extends through from the head of this run to the Pittsburg, Fort Wayne and Chicago railroad, at the State line, and is over a mile in length. The Freeport limestone, below the coal, is very compact, and of a light gray color

At the other end of this drift, where the railroad passes into Ohio, we see the following section, at the State Line Coal Company's works, 63½′: (Fig. 206.)

1. Sandstone and Sandy Shales,			10′
2. Coal, Upper Freeport,	1. Coal,	3′ 4″	4′
	2. Slate,	1″ to 2″	
	3 Coal,	4″ to 6″	
3. Fire Clay, .			1′ 6″
4. Limestone, Freeport,			3′
5. Concealed to level of R R. track here, 1,045 feet above tide, . . .			45′

The coal is mined at this locality by Mullen & Co., and is operated partly in Pennsylvania and partly in Ohio. The roof of the coal is generally a black slate 2 to 3 feet thick, but this, with the coal below it, is sometimes cut away by the Mahoning Sandstone, which comes down from above.

One and a half miles east from this, are the coal-works of Todd & Co., which are not now in operation. The coal comes at an elevation of 70 feet above the railroad, and is hauled on a tram road from the mouth of the pit, which is one half mile south. The coal is 4 feet thick, and the Freeport Limestone is seen below it.

Near the head of Dilworth's run, the Upper Freeport coal is mined, at the roadside, by Mr. Hartshorn, where it is 3 feet 8 inches thick, and quite good.

The Brush Creek Coal and mines

One mile south from Enon Valley Station, the Brush creek coal is mined on the land of Mr. Daniel Madden, by a shaft 36 feet deep.

The coal is 3 feet thick, and sometimes runs up to 3 feet 3 inches It is a splendid coal, being highly prized for smithing purposes. It comes 190 feet above the level of the railroad at Enon. Shales and Fire Clay were passed through in the shaft, according to Mr. Madden's statement.

A short distance north from this, the Brush creek coal is also mined on the land of Mr. Pickles, where it is 3 feet thick, and of excellent quality.

The *Upper Freeport coal* has thinned away at this locality so that only a few inches of it is seen, 50 feet below the Brush creek.

On Madden's run, 1½ miles south-east from Enon, the *Kittanning coal* is mined by Mr. McClure, where it is 2½ feet thick, and a very good coal.

Where the Enon and Darlington road crosses Madden's run, the *Darlington coal* was once mined by Mr. Madden, but the opening is now fallen in, and nothing could be seen of it.

The blossom of the Brush Creek coal is frequently seen along the Enon and Darlington road ; and, near the schoolhouse, one mile north from Darlington, the Upper Freeport coal is seen making a broad band of smut across the road Near this point it was once mined on the land of Mr Douthitt, where it is reported as 4 feet thick.

Boulders floated by icebergs ?

Strewn all over this township, are seen many huge boulders of granite. One of these seen near the head of Dilworth's run, is 10 feet in its longest diameter, and 6 in its shortest. They are found on the summits of the highest hills.

40 South Beaver Township, Beaver County.

This lies immediately south from Darlington township, and also adjoins the State of Ohio.

Little Beaver flows along its northern border, while Brush run heads up in the eastern part and flows west almost through its center, putting into the Little Beaver in Ohio, a short distance west from the State line Brady's run heads up in its south-eastern corner. Anderson's run puts into Little Beaver at Darlington, and one half mile above its mouth the Kittanning coal is extensively mined by Mr. Tice, at whose drift, we see the following 25′: (Fig 207.)

1. Dark Shales,			15′
2. 1. Coal,	Kittanning,	1′ 5″	2′ 4′
2 Slate,		1″	
3 Coal,		10″	
3. Fire Clay to bottom of Anderson's Run,			3′

The coal is very pure and clean, being brilliant, very black, and pitchy It is used for smithing, and is the source of supply for a long distance back into the country.

One half a mile above this we see the following on the land of Mr Sturgeon 117′: (Fig. 208)

1. *Coal*, Lower Freeport, reported,	3′
2. Concealed,	75′
3. *Coal*, Darlington, part Cannel,	1′ 6″
4. Concealed, .	35′
5 *Coal*, Kittanning, in bed of run,	2′ 4″

Here the Lower Freeport coal was once mined on the land of Mr. Sturgeon, but the old opening has fallen in, and the coal cannot be seen Mr Sturgeon says that it was an excellent coal, though quite hard to dig, from which I infer it was somewhat slaty.

The Darlington coal is seen in a ravine, and above it comes an impure cannel shale, 4 to 5 feet thick.

The Kittanning coal goes under the run at this point, and has been stripped out of the same, just below.

Three fourths of a mile above this, the Darlington coal was once opened by Mr. Ferguson, and it there had 10 to 15 inches of *cannel*, resting on 12 inches of bituminous coal. It is 10 feet above the run, at this locality, and a short distance above it passes under.

Opposite Elder's woolen mill, on the Little Beaver, we get, descending the steep hillside to the creek, 227′ feet of measures: (Fig. 209.)

1. Massive Sandstone, Mahoning, seen,	25′
2. Concealed,	135′
3. Massive Sandstone, Freeport,	15′
4. Dark Shales, containing streaks of Coal and nodules of Iron Ore,	10′
5. *Coal*, Kittanning, reported,	2′ 4″
6. Concealed, ...	15′
7. Sandstone and Sandy Shales to the level of Little Beaver, below the dam, . .	25′

The Mahoning Sandstone is very massive, and huge blocks of it are strewn all over the hillside, while the stratum itself forms a bold-cliff far up on the hill.

The Darlington coal has here very probably been eroded, before the deposit No. 3 was made as the Freeport Sandstone extends down so close to the Kittanning coal.

The Kittanning was once mined, but the drift is now abandoned, and the coal cannot be seen. It is reported, however, to have been 2 feet 4 inches thick, but of rather inferior quality.

Passing up on the ridge, one mile south from the woolen mill, we find the Upper Freeport coal mined by Mr. Elder, and Mr. Jackson. The two banks are but a short distance apart, and show the same section. The following section of 32½′ is seen at Mr. Jackson's: (Fig 210.)

1. Massive Sandstone, Mahoning, seen, ...			20′
2. Shales, ...			2′ 6″
3. *Coal*, Upper Freeport,	1. Coal, .	6″	4′ 6″
	2. Slate, .	¼″	
	3. Coal, . .	3′ 0″	
	4. Slate,	½″	
	5. Coal,	8″	
	6. Fire Clay,	2″ to 3″	
	7. Coal, impure, .	8″	
4. Fire Clay, ...			3′
5. *Limestone*, Freeport, ...			2′ 6″

Here the coal is mined quite extensively for local supply. The bottom and top layers are quite impure and worthless, but the main bench is a very fair coal, and is highly prized as a domestic fuel, though it contains rather too much sulphur for smithing

The (Upper) Freeport limestone below is a light gray rock, and very compact. It contains a small *bivalve crustacean*, of very minute proportions.

Passing one mile south from Mr. Jackson's, we come to Mr. McMillan's opening, in the Upper Freeport coal, and there in descending to his bank from from the road above, we get the following section of 117'. (Fig. 211.)

1. *Coal*, Brush Creek,			Blossom.
2. Concealed, .			35'
3. Massive Sandstone, Mahoning,			30'
4 Coal, *Upper Freeport*,	1. Coal, slaty,	8 "	4' 4"
	2. Coal,	2' 10 "	
	3 Slate,	½"	
	4 Coal,	3 "	
	4 Slate,	½"	
	6. Coal,	6 "	
5. Fire Clay,			2'
6. *Limestone*, Freeport,			3' 6"
7. Shales and Sandstone,			40'
8. *Coal*,			2'

Here the Upper Freeport coal shows the same slaty top and bottom layers, which it so often does. They are comparatively worthless, while the main bench is a tolerably fair coal, though containing more sulphur than usual.

The blossom of the Brush Creek coal is seen in the road, where it makes a large streak, and is probably 3 feet thick, but has never been opened.

The Mahoning Sandstone is quite massive, and forms vertical cliffs around the head of the little stream.

The coal No. 8 in the road below, has also been stripped out of the hollow by Mr. McMillan, who says it is an excellent coal.

Passing down to Brush run, we find the Kittanning coal showing its blossom, near the mouth of Little Brush run, 180 feet below where the Upper Freeport coal was seen at McMillan's The Kittanning is there 25 feet above the run, and was once mined on its left bank by Mr. Wilson, but the drift has long ago been allowed to fall into disuse, so that nothing can be seen of the coal, but I learned from Mr Wilson that it was a little over 2 feet thick, and quite pure.

The Fire Clay is seen below the coal, 10 feet thick. One mile above this the coal passes under Brush run

Nothing is seen of the Darlington coal at this locality, as everything is covered up and concealed by dèbris.

One half mile south from Brush run, the Upper Freeport coal is mined by Mr Hartford at an elevation of 200 feet above the stream. It is there 4 feet thick, and the structure is pretty nearly the same as at McMillan's bank.

One and a half miles south from Hartford's the Upper Freeport coal has been mined on the land of Mr. Moore and Mr. McDade; and descending the little branch of the run from Mr. Moore's opening, we get the following section of 76': (Fig. 212.)

1. Mahoning Sandstone, seen, .			10'
2. Coal, Upper Freeport,	1. Coal, .	. 3'	3' 9"
	2. Slate, . .	3"	
	3. Coal, .	6"	
3. Fire Clay,		.	2' 6"
5 Limestone, Freeport,	(Upper F. L.) .	.	2'
6. Concealed, . .			10'
7. Sandy Shales and Sandstone,			35'
8. Concealed, ...			10'
9. Limestone, Butler, .	(Lower F. L.)	.	3'

The lower part of the coal is very slaty and impure. Many openings have been made in the coal at this locality, and all but one, have been allowed to fall in.

No. 9 comes at the horizon of the Butler Limestone, or that one so often found below the Lower Freeport coal. It is somewhat ferruginous, and contains many nodules of iron. It was once burned for lime, but contains so much iron that it did not slake well.

At the very head of Little Brush, near the Ohio township line, the Upper Freeport has been mined on the land of Mr. Brown, and there we get the following structure: (Fig. 213.)

1. Massive Sandstone, Mahoning, ...			30'
2. Shales, ...			2'
3. Coal, . (U. F. C.) . .	1. Coal, . . .	3' 2"	3' 10"
	2. Slate, . . .	1" to 2"	
	3. Coal, . . .	6" to 8"	
4. Fire Clay, ...			2'
5. Limestone, Freeport, . . (U. F. L.) . .		. .	2' 6"

The coal has been extensively mined for local supply.

The bottom and top are both very bad, while the main bench is also filled with pyritous slate.

The limestone below the coal is quite pure, and of a light gray color. It was once burned on the land of Mr. Brown, and is said to have made a very nice, white lime.

Near the mouth of the South Branch of Brush run, or the one which puts into it at the stone school-house, the Lower Freeport coal was mined a long time ago on the land of Mr Johnston. It is reported to have been 3 feet thick, and quite good. Passing up the South Branch, one half mile, we find the same coal now mined on the land of Mrs. Tinnis, and there we see the following. (Fig 214.)

1 Sandy Shales,			. 10′
2. Coal, Lower Freeport,	1 Coal,	1′ 2″	3′ 4″
	2. Shale,	2″ to 3″	
	3. Coal,	2′	

The coal is tolerably good, though some portions of it are somewhat slaty. It is a brilliant, lustrous coal, and comes out in handsome blocks.

One mile above this, the same coal was once mined, on the land of Mr J. S. Garvin, where it was 3 feet thick. The bank has long ago been abandoned.

On this farm the Upper Freeport coal was also once mined, and is represented to be 4 feet thick. It comes 50 feet above the Lower Freeport.

A short distance above Mr. Garvin's the Lower Freeport goes under the stream, and has there been stripped along the bottom by Mr. Donahugh.

At the forks of the road above Donahugh's, the Upper Freeport coal goes under, and we pass up into the Lower Barren Measures, and see nothing but sandstone and red shales

Passing east from the head of the South Branch of Brush, we come down on to the head-waters of Brady's run, which heads up in the Barren Shales of the eastern part of this township. The stream soon cuts down through the Mahoning Sandstone, and where it passes out of the township is well down into the Freeport Sandstone.

41. *Chippewa Township, Beaver County.*

This lies directly east from South Beaver township, and extends east to the Big Beaver river

The main branch of Brady's run passes across its southwest corner, while the north branch of the same stream flows south and east through the township. This is the most broken and rugged district in the county. The streams flow in perfect gorges, cut down through the massive rocks of the Lower Coal Series, and the only farming land is high up on the hills in the Barren Measures.

Where the main branch of Brady's run comes into Chippewa township, it has cut down through the *Freeport Sandstone* for 70 feet, and at Davison's old mill the sandstone is seen in immense perpendicular cliffs along the stream, and enclosing it like the walls of a cañon.

A short distance below the old mill the stream cuts down to the *Darlington coal*, and its blossom is frequently seen along the bluffs, though no openings have been made in it along the stream in this township.

Near the head of the north branch of Brady's run the *Kittanning coal* is mined by Mr. Frank, and there we see the following in descending the bluff above 67': (Fig. 215.)

1. *Coal*, Darlington,			1' 4"
2. Concealed,			25'
3. Shales,			5'
4. Coal, Kittanning,	1. Coal,	10"	2' 8"
	2. Slate,	1"	
	3. Coal,	1' 4"	
5. Fire Clay,			8'
6. Concealed to bed of run,			25'

Here the Darlington coal was once opened, but it proved too thin to mine.

The Kittanning coal contains much sulphur in the shape of large "binders," and is not nearly so good a coal as we usually find it, though the binders are mostly confined to the upper bench.

The *Kittanning fire clay* below the coal is here very pure looking. Below this a short distance the coal was once mined by Mr. Niblock, and above by Mr. Taylor and

Mr. Rhodes, but all their banks have now fallen in and been abandoned.

The massive Freeport Sandstone is seen above the Darlington coal at this locality, and huge masses of it lie scattered over the hill

Passing up the hill from this point, north, toward the Darlington and Beaver road, we come to the Upper Freeport coal and its underlying limestone in the road, 180 feet above the Kittanning coal.

Near the brick school-house the blossom of the *Brush creek coal* is seen, and 85 feet below it the Upper Freeport coal has been opened by Mr. J. Dunlap, where it was 27 inches thick at the mouth of the drift, but on following it into the hill it thinned away to only 17 inches. It is rather impure and sulphurous.

One mile north-west from this the Upper Freeport coal is mined on the land of Mrs. McCarter, where we see the following section of 32′: (Fig. 216)

1. Massive Sandstone, Mahoning, seen,			25′
2. Coal, Upper Freeport,	1 Coal, Slaty,	6″	4′ 3″
	2 Coal,	2′ 6″	
	3 Slate,	1″	
	4 Coal,	8″	
	5 Clay,	2″	
	6. Coal,	4″	
3. Fire Clay, seen,			3′

The coal is very impure as its exposed surface is frosted over with copperas. The bottom part is also quite slaty This is at the head of Anderson's run.

One mile north-west from McCarter's the same coal is mined by Mr. Sanor and Mr. Hall at the head of a small stream which puts into the Little Beaver, just above Darlington Descending from Mr. Hall's bank, we see the following 61′: (Fig. 217.)

1. Flaggy Sandstone, seen,			10′
2. Coal, Upper Freeport,	1. Coal,	3′ 6″	4′ 7″
	2. Slate,	1″	
	3. Coal,	6″	
	4. Clay,	2″	
	5. Coal,	4″	
3. Fire Clay,			4′
4. Limestone, Freeport,		(U. F. L)	4′
5. Shales and Sandstone, and concealed,			35′
6. Coal, Lower Freeport, in bed of the run, reported,			3′

The Upper Freeport coal is quite variable in thickness, running down to 2 feet and up to 7 feet. The quality is much better than at McCarter's, the main bench being a very fair coal.

The U F L. is seen in a massive stratum, in the bed of the run below Mr. Sanor's coal bank. It is very hard and compact, and of a light gray color, weathering buff on exposure

Limestone.

About 70 feet above the Upper Freeport coal, Mr. Sanor finds a limestone of a slab-like structure in his field, and has burned it. It looks like the limestone which is seen under the Brush Creek coal, in Big Beaver township, and probably is the same. It made an excellent lime

The Lower Freeport coal was once stripped out of the bed of the run, at this locality. It is reported to be 3 feet thick, and a very good coal.

In the north-west corner of this township, three fourths of a mile from Darlington, the Kittanning coal is mined by Mr McMahon, at whose works we see the following 33½′: (Fig. 218.)

1. Sandy Shales,	5′
2. *Coal*, Darlington,	1′ 4″
3. Shales, bluish at the top but dark below, and containing Iron Ore,	25′
4. *Coal*, Kittanning,	2′ 2″

Here the Darlington coal has been stripped to some extent, while the Kittanning is extensively mined for local supply. It is a very pure coal, and shows very little pyrites.

Near the head of Thomas' branch of Brady's run, we see the following, on the land of Mr. Moore: (Fig. 219.)

1. Variegated Shales, red, buff, &c.,	75′
2. *Limestone*,	5′
3. Concealed and Sandstone, Mahoning,	50′
4. *Coal*, Upper Freeport,	3′ 6″
5. Fire Clay and Shales,	5′
6. *Limestone*, Freeport,	3′

Here the coal has been mined and stripped all around the head of the little hollow.

Limestone below Brush Creek coal.

No. 2 is the limestone, which occurs below the Brush Creek coal, in Big Beaver township. That coal, however, [illegible] is now absent, and we see nothing above it but the *variegated shales* of the Barrens for 75 feet. This is a series of red shales inter-stratified with yellowish and greenish marls, and an occasional streak of dark slate. The whole mass makes a barren soil, and is seen stretching across the fields in great bare patches, which have been furrowed deeply by gullies. South from this, along the Beaver and Darlington road, the *Barren shales* occupy the high hills, and are frequently exposed.

Passing down on to the Pittsburg, Fort Wayne and Chicago Railroad, the following section is seen on the land of Mr Hartman, one and a half miles above Beaver Falls Station 164′: (Fig. 220)

1. *Coal*, Darlington,	(*Upper Kittanning*,)		2′
2. Fire Clay,			5′
3. Shales, containing Iron Ore,			40′
4 *Coal*, Kittanning,	1. Coal, 2. Slate, 3. Coal,	1′ 1″ 1′ 3″	2′ 4″
5. Fire Clay,			10′
6 Sandy Shales,			50′
7. Concealed to level of the R. R.,			55′

The Darlington coal was once mined by Mr. Clayton, and is an excellent coal. At some places in the bank, Mr. Clayton reports it as attaining a thickness of 28 inches.

The Kittanning is a tolerably fair coal, though it contains considerable pyrites, and Mr. C says it will not begin to compare favorably with the Darlington above it

Near the top of this hill is a quarry in the *Butler Sandstone*, on the land of Mr. Hartman, from which a large amount of *building stone* is shipped on the railroad The stone is of excellent quality.

Twenty-five feet above the base of No. 7 occurs a coal, and just above here, near Harbisson's run it shows the following. (Fig. 221.)

1. Coal, 2. Clay, 3. Coal,	Brookville C ?	1′ 2″ 3′ 7″	4′ 9″

The Brookville Coal?

This comes at the horizon of the Brookville coal, and is doubtless that stratum, as the *Piedmont Sandstone* comes in immediately below. The coal was opened by Mr. Harbisson, but is too slaty to mine.

At Mayfield station a drift was run in on this same coal for several yards, but no available coal was found, though there it makes a large show of blossom in the cut near the station.

42. Patterson Township, Beaver County.

This is a small area lying in the narrow neck between Brady's run and the Big Beaver.

The strata are finely exposed along the Beaver, in this township, as its banks are almost vertical, and sections can frequently be obtained where *every inch of the strata* is exposed, for 300 feet.

Three fourths of a mile above Beaver Falls Station, the *Kittanning coal* is mined along the railroad, above the track, by Hulmes & Bro., and also by Mr. Davis, their works being only a few rods apart. Here the coal shows the following structure: (Fig. 222.)

1. Coal,	Kittanning Coal,.	1' 2''	2' 4''
2 Slate,		1''	
3. Coal,		1' 1''	

There is quite a difference in the two benches of coal; the upper is a hard, dull, open burning coal, and contains some pyrites, while the lower bench is a bright, oily, soft caking coal. Much of the lower part comes out as slack and smut coal, and is then coked. The *bee-hive oven* is used, and the coal is coked 36 hours. Each bank has two ovens. The coal makes a most beautiful coke, being very firm and porous, and having a clear, silvery luster. It is largely used by the manufactories in Beaver Falls.

Beaver Falls is supplied with coal principally by these two banks. Each puts out about 1,000 bushels every day. The coal is there 190 feet above the level of the Beaver.

New Brighton long Section No. 1 of 363'.

One mile below this a little run puts into the Beaver, a short distance above the toll bridge, connecting New Brighton and Beaver Falls, and descending this from the top of the hill, we see the following section of 363': (Fig. 223.)

1.	Massive Sandstone, Mahoning, seen,			15′
2.	*Coal* Blossom, Upper Freeport.			
3.	Concealed,			40′
4.	Massive Sandstone, Butler,		(U. F. SS.)	30′
5.	*Coal*, Lower Freeport, Blossom.			
6.	Concealed and Sandstone,		(L F. SS.)	70′
7.	*Coal*, Darlington,			1′ 6″
8.	Fire Clay, Shales, and concealed,			35′
9	*Coal*, Kittanning,	1. Coal,	10″	2′ 1″
		2. Slate,	1″	
		3. Coal,	1′ 2″	
10	Fire Clay,			8′
11	Sandstone and Sandy Shales,			65′
12	*Limestone*, Ferriferous,			2′
13	Concealed to level of the Beaver,			95′

Here the blossom of the Upper Freeport coal is seen in the road, on the hill top, where it makes a large, black streak, and is probably of workable thickness.

The Mahoning Sandstone above it is very massive.

No. 5 represents the Lower Freeport coal, and makes a small blossom in the road.

The Upper Freeport Sandstone above it is very massive, and is quarried at the roadside. It is a coarse, reddish-white rock, and makes a very fair building stone, though it does not resist the weather so well as the Mahoning above.

The Lower Freeport Sandstone is not massive, but a flaggy sandstone inter-stratified with shales

The Darlington coal is seen at the roadside, and in the hollow below. It is a very pure coal, but too thin to mine.

The Kittanning coal is mined just below the road by Messrs Ross and Smith, where it is a bright, rich looking coal, and shows very little pyrites.

The Ferriferous Limestone is seen in the bed of the little run. It is rather impure, and exhibits the "cone-in-cone" structure.

The Gas Well of the Economy Company at New Brighton.

A short distance above this is the deep well bored by the Economy Society for gas at their cutlery-works. It commences immediately on top of the Upper Homewood Sandstone.

New Brighton long Section, No. 2 of 362′.

A short distance below the toll bridge connecting Beaver

Falls and New Brighton, a small stream plunges down the hill and exposes everything from the top of the hill to the bottom The section there is as follows: (Fig. 224.)

1.	Massive Sandstone, Butler,	(Upper Freeport SS.)	35'
2.	Coal, Lower Freeport,		1' 4''
3.	Fire Clay,		5'
4.	Limestone, Butler,		2'
5.	Shaly Sandstone, Freeport,	(Lower Freeport SS)	60'
6.	*Coal*, very impure, local,		1'
7.	Shales, Sandy,		20'
8.	*Coal*, Darlington,	(U. K C.)	1' 4''
9.	Fire Clay and Sandy Shales,		10'
10.	Dark Shales, containing Iron Ore,		25'
11.	Coal, Kittanning,	(L. K. C)	2' 4''
12.	Fire Clay,		9' 6''
13.	Sandstone,		42' 6''
14.	Sandy Shales,		30'
15.	Ferriferous Limestone,		6'' to 1' 6''
16.	Black Fossiliferous Slate,		15' 6''
17.	Fire Clay,		7' 6''
18.	Sandy Shales,		10'
19.	Fire Clay, non-plastic,		3'
20.	Flaggy Sandstone,		23'
21.	Blueish Sandy Shales, containing Iron Ore,		25' 6''
22.	*Coal*, Brookville,		6''
23.	Fire Clay,		4'
24.	Shaly Sandstone,		6'
25.	*Massive Sandstone, Piedmont*, to level of Beaver,		20'

The *Butler Sandstone* is quite massive, and forms a long line of cliffs around the top of the hill. The rock has weathered away very much, and is pitted with holes and queer-shaped cavities. This cliff is called the "*Alum Rocks*," from the aluminous sand which lies loosely about the base of the stratum and has been derived from its waste. This stratum was *formerly considered the Mahoning* Sandstone, as the limestone below the coal was always considered the Freeport

No. 2, the Lower Freeport coal is very impure, containing much sulphur.

The Butler or Lower Freeport Limestone is tolerably compact, but quite ferruginous, as we always find it.

The Freeport Sandstone is somewhat shaly, and has lost the massive character which it displays along the Ohio river.

No. 6 is a *local coal*, which sometimes occurs at this horizon, though it never becomes workable.

The Darlington coal is remarkably pure, and its exposed surface is clean and bright, and free from any incrustations of copperas.

The Ferriferous Limestone is very thin, and is seen varyin thickness from one half foot to 1½, within a short distance. It has the "*cone-in-cone*" structure.

The black shales below it are very fossiliferous, and at their base become quite bituminous, and may then represent the *Clarion coal*, as there is nothing else in the section to take its place, and this is confirmed by the presence of the large bed of fire clay, below the shales, since the Clarion is underlaid by a bed of about that size, where seen opposite Beaver Falls.

Fucoids on under surface of iron ore.

No. 21 is filled with "Kidney" *iron ore*, and near its base is a layer of calcareous ore, which has its lower surface completely covered with fucoids They are of various forms, and branch off in every direction. One was seen which radiated from a central axis something like the *Rotophycus* of Lesquereux.

No. 22 represents the *Brookville coal* of Rogers. It is only 6 inches thick, but about one half mile below, where it has dipped down to the water, it becomes 3 feet thick, as is reported by the men who worked at building the dams along the Beaver, when the Erie and Pittsburg canal was constructed.

The *Piedmont Sandstone* is seen along the Beaver, forming a cliff on either side. One half mile below here its top comes down to the bed of the river at the first dam, and the water falling over on it makes a very rapid current. The rock is worn into all manner of pot-holes, and huge furrows are cut down into its softer portions.

The Brady's run (Beaver Co.) Section.

On Brady's run, nearly opposite the Fallston bridge, the following section of 162′ was made out, on the land of Mr. Middleton: (Fig. 225.)

1. Sandy Shales,	10′
2. *Coal*, Darlington,	1′ 8″ to 1′ 11″
3. Fire Clay and Sandy Shales, containing Iron Ore,	35′
4. *Coal*, Kittanning,	2′
5. Fire Clay,	8′
6. Sandstone and Sandy Shales,	60′
7. *Limestone*, Ferriferous,	5′
8. Concealed to Brady's Run,	40′

The *Darlington coal* is here mined by Mr Middleton It is quite pure, and a very brilliant, rich coal. It varies from 15 to 23 inches in thickness, never getting less than the former nor more than the latter. The *Kittanning coal* has also been mined immediately below where the Darlington is opened, but Mr. Middleton says it is much inferior to the Darlington, as it contains considerable sulphur.

The Ferriferous Limestone is seen in the bank below the coal, and is in two layers, separated by 3 inches of shale.

On Thomas' run, a branch of Brady, the Kittanning coal is mined on the land of Mr. Platt, where we get the following: (Fig 226.)

1. Shales, dark, seen,			3′
2. Coal (Kittanning),	1. Coal,	10″	3′
	2. Slate,	1″ to 2″	
	3. Coal,	2′	
	4. Clay,	1″	
	5. Coal,	2″	
3. Fire Clay, seen,			2′
4. Concealed to the run,			25′

The coal has here an extra parting of clay near the bottom, and below this is very impure The main bench is a tolerably fair coal, and supplies the neighboring country.

43. Brighton Township, Beaver County.

This lies south from Chippewa and Patterson. The Big Beaver flows along its eastern border, and the Ohio along its southern, while Brady's run passes along its northern border and forms the boundary between it and Patterson.

A short distance below where the West Branch of Brady's run enters this township from Chippewa, the Kittanning coal comes up above water-level and its blossom is seen along the road with the Darlington, 40 to 45 feet above it, and the immense Freeport Sandstone capping the bluffs above.

There have been numerous openings in both coals, along this stream, but nearly all are now abandoned.

Near the old mill, one half mile below where Brady's run enters the township, we see the following at one of these abandoned openings 95′: (Fig. 227)

1. *Coal*, Darlington (reported),	(U. K. C.),	1′ 8″
2. Shales,		40′
3. *Coal*, Kittanning (reported),	(L. K. C.),	3′
4. Concealed to the creek,		50′

Here both coals were mined a long time ago, but the banks have fallen in now. I have given their thickness as reported to me by a man who had dug in each.

Passing on down the stream we find the *Kittanning coal* mined on the land of Mr. David Morgan, and there it exhibits the following structure : (Fig. 228)

1. Coal,	Kittanning coal,	7″	3′
2. Slate,		1″	
3. Coal,		2′ 4″	

The coal is very good, being lustrous and brilliant, and containing very little sulphur, except an occasional large "binder," which can be easily separated from the coal.

This is the only coal bank now in operation on this stream, in this township, though the coal is constantly accessible for several miles, and is 2½ to 3 feet thick all the time Numerous openings have been made, but they have all been allowed to cave in, and have been abandoned. The farmers say it is cheaper to buy their coal and haul it some distance than to keep a bank open, and this is doubtless true, since the average farmer manages so to construct his entry that it lasts only for the time being, and a new one must be made the next year.

Here at Mr. Morgan's the *Darlington coal* is seen in a small ravine, 45 feet above the Kittanning, and has been dug out for smithing, being very pure, but only 18 inches thick

Brady's Run West Branch Section of 187′.

One mile above the mouth of the West Branch of Brady's run we get the following section in descending a ravine to the stream 187': (Fig 229.)

1. Massive Sandstone, Freeport, seen (cliffs),	30'
2 Sandy Shales,	15'
3 *Coal*, local,	0' 4''
4 Sandy Shales and Sandstone,	20'
5. *Coal*, Darlington,	1' 6''
6 Fire Clay,	7'
7. Shales, containing Iron Ore,	35'
8. *Coal*, Kittanning,	2' 6''
9. Fire Clay,	10'
10. Sandstone and Sandy Shales,	60'
11. *Limestone*, Ferriferous,	1'
12. Dark Shales, containing nodules of Iron Ore, to the level of Brady's Run,	10'

The (*Lower*) Freeport Sandstone is very massive and extends around the hill in an immense cliff

Both the Darlington and Kittanning coals have been stripped out of the ravine at this locality, and both are underlaid by very thick and pure beds of fire clay

The Ferriferous Limestone is quite impure and shows the "*cone-in-cone*" structure. The *shales* below it are crowded with *fossils*. Descending Brady's run to its mouth we find there have been numerous mines in the Kittaning coal, but all are now abandoned

At the mouth of this stream the top of the *Piedmont Sandstone* is seen in the bottom of the creek, and 10 feet above it the *Brookville coal* attains workable dimensions. It was once mined and used as a fuel in the manufacture of salt at the old salt-works there. It was 3½ feet thick, but quite slaty.

Oil Wells of the Lancaster and Beaver Company.

A few feet from the mouth of the old coal drift two wells were bored for oil by the Lancaster and Beaver River Oil Company. No records of these borings are accessible, and all that can be learned is their depths, which are 1,080 feet and 1,375 feet. The latter is still flowing *gas* and *salt* water. One of these wells was originally bored for a salt well, and salt was manufactured here for a long time by Mr. Dickey. The water came at 360 feet below the Brookville coal. Some show of oil was obtained in these wells, but they were never pumped.

The *Kittanning coal* was once mined at this locality on the land of Mr Ray, but the available coal is now all mined.

One half mile below here the same coal is mined on the land of Mr Bromley at the head of a small stream, which puts into the Beaver through the village of Bridgewater, and at his drift we see the following: (Fig. 230)

1.	1. Coal,	Kittanning,	6″	2′ 8″
	2. Slate,		1″ to 2″	
	3 Coal,		2′ 0″	
2.	Concealed to the river,			125′

The coal varies much, both in thickness and quality In drifting in some directions it becomes slaty and bony and utterly worthless, while in other directions it is very good. It contains too much pyritous slate for smithing purposes.

Below this a short distance we see the following section descending from the top of the hill of Mr. Fell 285′: (Fig. 231)

1. *Coal*, Upper Freeport,	Blossom
2. Shales and Sandstone,	70′
3 *Coal*, "Lower Freeport,"	1′ 6″
4. Sandstone, Freeport,	60′
5 *Coal*, Darlington,	1′ 4″
6. Concealed,	30′
7. *Coal, Kittanning*,	2′ 6′
8. Concealed to level of Beaver,	120′

Just above No. 1 of the section, occurs a very handsome *terrace*, and it is seen to be continuous with one at that elevation above Rochester, on the opposite side of the Beaver. This is the one which ranges at a height of from 280 to 300 feet above the Ohio river; and is seen at Bellevue.

The Upper Freeport coal is seen near the top of the hill in a broad band of smut It was once opened here, but nothing could be learned of its thickness. A shaft 20 feet deep was once sunk to the Kittanning coal at this locality, by Mr. Fell, but it proved to impure and slaty to mine.

The town of Beaver is situated on a very beautiful *terrace*, 120 feet above the level of the Ohio. It is a mere mass of rounded boulders and loose sand. This is the same terrace on which the railroad runs through New Brighton.

Two and one half miles below the mouth of Big Beaver, Two-mile run puts into the Ohio, and, stripping off the terrace deposits, exposes the *Ferriferous Limestone*, near its mouth. This stratum has thickened up considerably from what we last saw it, 3 miles to the north-east, as it is there only 2 feet thick, while here it is from 10 to 15 feet. It has been mined and burned at this locality for a long time. Just back from Vanporte, are some *quarries* on the land of Mr Powers, which are now operated by Mr. Dunn, and there we see the following section of 46½': (Fig. 232.)

1. Sandy Shales,		5'
2. Limestone, Ferriferous—		11' 6"
a. Dark, though impure, Limestone,	1'	
b. Blueish-gray Limestone,	3'	
c. Shale,	0' 4" to 0"	
d. Light gray Limestone,	3'	
e. Blue Limestone,	4'	
3. Concealed to the level of the Ohio,		30'

The limestone differs very much in the various layers, both in color and quality. The upper layer (*a*) is a dark tough impure rock, not used. The bluish-gray stratum (*b*) extremely brittle, is said to be the best for fluxing iron, and has been shipped to Pittsburg and Mingo for that purpose The shale (*c*) is persistent, in all the quarries here. The light-gray layer (*d*) the most compact and purest limestone in the bed, burns into a very fair white lime, and is nearly a pure carbonate.

The blue portion (*e*) is quite impure in its lower part, and cannot be used. The whole bed is richly fossilferous.

Below this, one fourth of a mile, Mr. Davis has a quarry in this rock below the railroad, and he ships it to Mingo Furnace.

The Vanporte Section of 219'.

One half mile below Vanporte, we see the following section on the land of Mr. Severn 219': (Fig. 233.)

1. Massive Sandstone, Freeport,		60 '
2. Shales,		10 '
3. *Coal*, Darlington, (U. K. C.)		1 ' 6"
4. Shales, containing Iron Ore,		35 '
5. *Coal*, Kittanning, (L. K. C.)		2' to 2 ' 6"
6. Fire Clay,		11 '
7. Sandstone and Sandy Shales,		44 '
8. Iron Ore,		0' to 2 '
9. *Limestone Ferriferous.* 1. Limestone, gray,	7'	18 '
2. Shale,	1'	
3. Limestone, blue,	10'	
10. Concealed to the Ohio River,		35 '

Here the Kittanning coal is mined by Mr. Severn. It is quite impure and slaty, however, and is very inferior.

The Kittanning fire clay is very good, and is used by Mitchell & Co., in the manufacture of Fire Brick at this locality

The Ferriferous Limestone (10) shows a very different structure from that at Power's quarry, only one half mile above Here it is much thicker and more massive. At the quarry, which is Mr. Tygart's, a sandstone rests on the limestone and no iron ore is seen, but only 3 rods above, we get 2 feet of *plate ore* resting immediately on the limestone.

The limestone is also quarried by Mr. Severn. This is the last locality at which this rock is seen on the north side of the river, until we come to the Ohio line, as it dips down below the terrace, and is continually covered up, when not below the level of the Ohio as it frequently is. The Darlington coal blossom is seen here, and Mr. Severn, who has dug into it, says it is 1½ feet thick, and quite pure.

The Freeport Sandstone is seen forming a massive cliff above it. Passing up Two-mile run it rises very fast and the limestone soon goes under.

On the land of Dr. McKinney, 2½ miles above the mouth of this stream, we get the following section of 153': (Fig. 234.)

1. Massive Sandstone, Mahoning,	20 '
2. *Coal*, Upper Freeport,	2 '
3. Fire Clay,	2 '
4. *Limestone*, Freeport,	2 ' 6''
5. Shales and Sandstone,	60 '
6. *Coal*, Lower Freeport,	1 ' 8''
7. Concealed, with occasional exposures of Sandstone, to the level of Two-mile Run, ...	65 '

The Mahoning Sandstone is very massive and immense outliers of it are scattered over the hill. Just above here it is quarried, and it makes an excellent building stone.

The coal comes immediately below it and is too thin for mining.

The limestone under the coal is quite ferruginous and brecciated

The Lower Freeport coal has been opened and mined by stripping, but it is too thin and slaty to be of any value

Passing on up Two-mile we find the Upper Freeport coal going under it on the land of Mr Morgan; and, ascending the hill, we see a large coal blossom in the road 140 feet above. This is one of the *Barren Measure coals*, which come in at all horizons, and occasionally become workable.

Lower Barren Measure Red Shales.

At Mr. Gibson's, near the north-west corner of the township, on the New Lisbon and Beaver road, a large bed of red clay is seen near the top of the hill, 300 feet above where the Upper Freeport coal was last seen. This is very probably the red clay, which almost constantly underlies the *Crinoidal Limestone.* But the place of the limestone is concealed by debris, though it is doubtless present in the high knob which rises 50 feet above the red clay.

Going south from the New Lisbon road on to the head of Six-mile run we find the *Mahoning Sandstone* in immense development, forming perpendicular cliffs along the stream and covering the ground with its large fragments.

The *Upper Freeport Coal* comes to the surface one half mile above the forks of the run, and is first mined by Mr. Nevill, at an elevation of 30 feet above the stream. The coal is 2½ feet thick, and not very pure. The U. F L. is seen below it in blocks which have slid out of the hill. On the left branch of the stream this coal is mined by Mr. Walton, a short distance above the forks, and there we see the following section of 98′: (Fig. 235.)

1. Massive Sandstone, Mahoning,	25′
2 Sandy Shales,	35′
3. *Coal*, Upper Freeport,	3′
4. Concealed to the run,	35′

The coal is quite variable in thickness, running from one to three feet. It contains considerable sulphur. This is the last opening as we ascend the left branch, and half a mile above the coal passes under.

One half mile below the forks of the run this coal is mined to a considerable extent by Mr. McGaffich, and at his drift we get the following section of 60′: (Fig. 236.)

1. Coal, Upper Freeport,	1. Slaty Coal, .	1' 0"	5'
	2. Shale,	0' 6"	
	3. Cannel,	0' 6"	
	4. Coal,	2' 8"	
	5. Slate,	0' 1"	
	6. Coal,	0' 4"	
2. Concealed,			10'
3. Sandstone, (*Butler, U F Sandstone*)			40'
4. *Coal,* Lower Freeport,			2'
5 Concealed to the run,			3'

The roof coal is very impure and is never taken out The layer of the *cannel* on top of the main bench is quite good and is taken out and sold along with the rest.

This bank is the source of supply for a considerable distance around in the country The coal contains too much sulphur for smiths' use

The tolerably massive sandstone, No. 3, comes at the horizon of the one I have called the Butler.

The coal bed under it has been mined at one time, and is a kind of semi-cannel at the mouth of the drift and very slaty, but, when further under the hill, it is reported to be a tolerably fair cannel A short distance up the stream it turns into a bituminous shale, and disappears.

On the branch of Six-mile run, which comes in past the school-house below McGaffich's, the Upper Freeport coal has been opened in several places on the land of Mr. Lister, and there we see the following section of 45': (Fig. 237.)

1. Massive Sandstone, Mahoning,	40'
2. Shales,	2'
3 Coal, Upper Freeport,	3'

Here we see quite a change in condition within a short distance. At Mr. Walton's, only one mile above, the *Mahoning Sandstone* was separated from the coal by 35 feet of shales, while here it rests immediately upon the coal. The sandstone at this locality is a most beautiful *building stone.* It is of a grayish white color, splits evenly and freely into blocks of any desired size, and dresses easily. It has been extensively quarried and hauled to Beaver for building stone.

44. Industry Township, Beaver County.

This lies south-west from Brighton, and adjoins Ohio township. The Ohio river forms its southern boundary, and it is drained by Six-mile and Wolf runs, which put into the Ohio near each other.

Passing on down Six-mile run, from where we left it in Brighton township, we find the *Upper Freeport coal* mined just within the township by Mr Engle, and there we see the following section of 68½′: (Fig. 238)

1.	1. Cannel,	U. F C.	2 ″ to 6″	3′ 6″
	2. Coal,		2′ 8 ″	
	3. Slate,		⅛″	
	4. Coal,		4 ″	
2.	Concealed to the creek.			65′

The coal is rather inferior, and shows much pyritous slate. The roof coal seen at Mr. McGaffich's bank, a short distance above in Brighton township, is not present here.

The Kittanning coal is mined one half mile above the mouth of Six-mile run, on the land of Mr. Howe, and there we see the following section of 69′: (Fig. 239.)

1. Dark Sandy Shales, containing Iron Ore,			10′
2. *Coal*, Kittanning,	1. Coal,	6″	3′ 4″
	2. Slate,	2″	
	3. Coal,	2′ 8″	
3. Fire Clay,			6′
4. Sandstone, somewhat massive, to the level of the creek,			50′

The coal is quite good, and is very oily and brilliant, but has nearly all been mined out on this property.

The *Kittanning Sandstone* under the coal is very massive, and is seen in a perpendicular cliff.

On the opposite side of the Ohio from this point, only one half mile away, the *Ferriferous Limestone* is seen under this sandstone, 15 feet thick.

At Industry, one half mile below this last locality, the Kittanning coal is mined by Mr. Briggs, and, at his bank, it gives the following section: (Fig. 240.)

1.	1. Coal,	Kittanning C.	8″	4′
	2. Slate,		1″ to 2″	
	3. Coal,		2′ 9″	
	4. Cannel,		0″ to 14″	

Here the coal shows the very queer freak of having a layer of *cannel at the bottom.* Mr. Briggs reports that the cannel layer is very irregular in its thickness, sometimes running out entirely, and again thickening up to 14 inches. It is rather impure, but burns quite well

The main body of the coal is very good, being pitchy and bituminous, and would evidently make a good gas coal. Mr B. states that, in some parts of his bank, the coal thickens up to 5 feet

The Industry salt, oil and gas well

Mr. Briggs also operates the salt-works at Industry. The well is 800 feet deep, and was bored originally for oil. It commences 12 feet below the Kittanning coal, and a show of oil and some gas was obtained at 730 feet The salt water is obtained at 310 feet, which puts it far down in the Conglomerate Series. The water is 6° strong. About ten barrels of very fine, nice salt are made here daily. It takes about twenty barrels of water to make one of salt

The Industry long Section of 383½′.

In descending a ravine from the hill-top, at Industry, to the Ohio, we get the following section of 383½′: (Fig. 241)

1	Massive Sandstone, Buffalo, (?)	20′
2	*Coal*, Brush Creek,	Blossom.
3	Shales, and concealed,	20′
4.	Massive Sandstone, Mahoning,	70′
5.	Shales,	5′
6.	*Coal*, Upper Freeport,	4′
7.	Sandy Shales and Sandstone,	60′
8.	Concealed,	10′
9	Sandstone, (Lower) Freeport (one solid mass),	100′
10	*Coal*, Darlington,	1′ 6″
11.	Shales, and concealed,	30′
12.	*Coal*, Kittanning,	3′
13.	Concealed to the Ohio River,	60′

No. 1 is quite massive, and caps the hill. It very probably represents the *Buffalo Sandstone.* Immediately under it comes the blossom of a coal, which is at the horizon of the *Brush Creek coal.*

The Mahoning Sandstone is a very massive rock, and forms a line of cliffs along the hills. Huge masses of it lie scattered over the surface.

The (Lower) *Freeport Sandstone* attains an immense development, perfectly *massive, for the entire 100 feet* without a solitary break. It is a very hard, grayish-white rock, and 35 feet above its base is seen a blue silicious layer, worn perfectly smooth by the little stream which plunges over it.

The Upper Freeport coal was once mined here, but the opening has now fallen in, and it cannot be seen. Mr. Briggs, however, tells me that it was 4 feet thick

The Darlington coal has not been mined in this locality, except by stripping occasionally. It is a very pure coal, however.

The Kittanning coal was once mined by Mr. Cummings, a short distance below Industry, but it was rather slaty there, and has been abandoned.

Wolf run puts into the Ohio at Industry. The stream falls very rapidly, going down at the rate of 150 feet per mile, while it is passing through the great (Lower) Freeport Sandstone.

Passing up the right branch of the stream, we find the *Upper Freeport coal* on the land of Mr. Moore, one and a half miles from the river. Here the coal is 3 feet thick, and said to be very good. The mine is not now in operation, and the coal could not be seen.

Just above this, the coal goes under the stream, and is 280 feet above the Ohio, at Industry.

Going up on to the divide, we find the *Barren Measures* extending up for 270 feet above the Upper Freeport coal.

Passing down on to the left branch of Wolf run, we find the Upper Freeport mined, first by Mr. Reed, where we see the following 42½′: (Fig. 242.)

1. Shales,			5′
2. Coal, Upper Freeport,	1. Coal,	2′ 3″	2′ 6″
	2. Slate,	½″	
	3. Coal,	3″	
3. Concealed to the creek,			35

The coal is quite impure, being sulphurous and slaty.

On another branch of Wolf run, the coal was once mined by Mr. Nevill, and last above by Mr. Potter, where it passes under the stream.

One mile above Industry, the Upper Freeport coal is mined by Mr. Burtt, and at this drift we see the following: (Fig. 243)

1. Sandstone, Mahoning,			?
2. Coal, Upper Freeport,	1. Coal,	2′ 9″	3′ 1″
	2. Slate,	½″	
	3. Coal,	4″	
3. Concealed to the creek,			65′

The coal is here much better than at Mr Reed's bank above, though it still contains considerable sulphur.

A short distance below this, the coal is opened on the left bank of the creek by Mr. Luce, and on the right by Mr. Wilging. These banks show about the same section as Mr. Burt's.

Just below this were the old Cummings coal-works, where this coal was once extensively mined, and shipped by river and rail. The mines are now abandoned, as the coal was too poor to bear shipment.

One mile below Industry, the (*Lower*) *Freeport Sandstone* forms a *vertical cliff* of massive sandstone along the railroad, 120 feet high.

Near Cook's station, the *Kittanning coal* is mined on a small scale by Mr. Phillis.

The road leaving the railroad there passes up on to a beautiful *terrace*, which extends along the river from this point for three miles. Its top is 120 feet above the Ohio, and it consequently covers up all the lower rocks and coals, which come below its horizon.

45. Ohio Township, Beaver County.

This lies immediately west from Industry and Brighton townships, and adjoins the Ohio line, its southern boundary being the Ohio river.

Its draining streams are all small. They rise near its center, and pass with a very rapid fall into the Ohio and Little Beaver, which empties into the Ohio, just at the south-western edge of the township.

At the eastern boundary of the township, on the Ohio river, the *Kittanning coal* is only 40 feet above water level, but the river, taking a crook to the north-west below this point, the same coal is carried 100 feet above the Ohio, three fourths of a mile above Smith's ferry, where the river again turns south-west, and the coal keeps about that horizon above it until we come to the State line.

The beautiful *terrace*, on which we passed out of Industry township, continues at the same level for a considerable distance down the Ohio, and only disappears about one mile above Smith's ferry, when the river changes to the northern shore, and the terrace passes to the southern side

Upper Smith's Ferry long Section of 457½'.

About one mile above Smith's ferry, a very high, steep hill extends far up into the Lower Barrens, and, descending it, we get the following section of 457½': (Fig. 244.)

1. Sandy Shales,			20'
2. *Limestone*, "Pine Creek,"			2'
3. Sandstone and Sandy Shales, Buffalo,			65'
4. *Limestone*, "Brush Creek,"			1'
5. Concealed, but showing blossom of *Coal, Brush Creek*,			5'
6 Massive Sandstone, Mahoning,			80'
7. *Coal*, Upper Freeport,	1. Coal,	2' 0''	3'
	2. Slate,	½''	
	3 Coal,	3''	
	4. Slate,	1''	
	5. Coal,	8''	
8. Fire Clay, seen,			2'
9 Concealed,			5'
10. Sandstone and Sandy Shales,			50'
11. *Bituminous Slate and Coal*, Lower Freeport,			5'
12. Fire Clay and Shales,			2'
13. *Limestone*, Butler,			3'
14. Massive Sandstone, Freeport,			65'
15. Shales, dark Sandy,			10'
16. Coal, Darlington,	1. Coal,	1' 7''	2'
	2. Slate,	2''	
	3. Coal,	3''	
17. Fire Clay,			5'
18. Shales, containing Iron Ore,			20'
19. *Coal*, Kittanning,			2' 6''
20. Fire Clay,			10'
21. Concealed to the river,			100'
22. *Piedmont Sandstone* in the bed of the Ohio, at low-water mark.			

Here I was very agreeably surprised at finding the two little limestones, which are so persistent in the Lower Barrens of Allegheny county.

The *Pine Creek Limestone* is a somewhat hard arenaceous rock, and contains many fossils, among which I saw *Orthoceras cribrosum* It rests immediately upon a massive plate of sandstone, which gradually becomes shaly below. This, No. 3, represents the *Buffalo Sandstone.*

The Brush Creek Limestone has the dark-blue slaty appearance, as so often in South Beaver, and other localities. It is also fossiliferous here, and, in it, were seen, *Chonetes mesoloba*, *Nautilus occidentalis*, *Athyris subtilita* and *Productus Nebrascensis.*

The blossom of coal under it doubtless represents the Brush Creek coal bed

The *Mahoning Sandstone* is an immense stratum forming a vertical cliff 80 feet high, which extends around the hill at this locality; it is a coarse grayish-white rock, and some portions of it are *conglomeratic.* Huge masses of it have broken off the cliff and lie scattered over the hill below.

The Upper Freeport coal has here been gouged out of the hill from time to time, and the coal is well exposed, though it has never been regularly mined. It contains much sulphur, and is a thoroughly bad coal in every way.

Under it occurs a bed of *iron nodules*, which have been tested for mineral paint, and are said to make an excellent paint of various shades, one of which is a very nice blue. They come where the (U.) Freeport Limestone is usually found, as that stratum seems to be absent here, or else is in the concealed interval.

The Lower Freeport coal represented by No. 11, is a bed of very bituminous slate, intermixed with coal, and some parties once drove an entry on it for several yards, thinking it would turn into cannel coal, which, of course, it never did.

The Butler (L. F.) Limestone is under the coal, and quite ferruginous; it has a shaly irregular fracture, and is a dull-buff color on its weathered surface.

The Freeport Sandstone is also quite massive, and forms the first bluff along the railroad. It is seen extending in a vertical cliff around the hill. The rest of the section under this sandstone was obtained a short distance below at the fire brick-works of Walker & Co.

The Darlington coal, No 15, has there been mined and used in burning the fire brick. It is a very clean bright coal, and contains very little pyrites, except in the small bottom coal, which is slaty and impure.

The Darlington Fire Clay is also very good, and has been used at the fire brick-works.

No. 17 is filled with large nodules of *iron ore*, which is tolerably rich.

The Kittanning coal is very impure, containing so much sulphur and slate that it is termed the "Sulphur Vein." The Kittanning Fire Clay under it is very large, quite pure, and manufactured into fire-brick of a superior quality by Walker & Co. Only about 7 feet of the clay is mined, as the lower part is too silicious.

Sculptured Rocks; Piedmont Sandstone.

At low-water mark, here along the shore of the Ohio river, is seen a massive white sandstone, and on it are carved drawings of men, birds, and various other animals, together with many symbolic characters, which have never yet been interpreted. They are doubtless the work of the aborigines. The rock, on which they are cut, is the Piedmont Sandstone.

The Smith's Ferry Section of 180'.

At Smith's ferry we see the following near the mouth of Dry run 180½': (Fig. 245.)

1. **Massive Sandstone, Freeport,**			40'
2. **Sandy Shales,**			15'
3. ***Coal,* local, impure,**			1'
4. **Sandy Shales,**			20'
5. ***Coal,* Darlington,**	1. Coal,	1' 6''	1' 11''
	2. Slate,	2''	
	3. Coal,	3''	
6. **Fire Clay,**			5'
7. **Shales, containing Iron Ore,**			15'
8. ***Coal,* Kittanning,**			2' 6''
9. **Fire Clay,**			10'
10. **Sandstone and Sandy Shales to the R. R.,**			25'
11. **Concealed to Ohio River,**			45'

The local coal bed, No. 3, of the above section, is an impure, slaty coal.

The Darlington coal is seen in the bank where the road has been cut around the hill. Exposure to the weather seems to have no effect upon it.

The Kittanning coal was once mined here and used as a fuel in boring for oil, but the opening is now fallen in and abandoned, so that the coal cannot be seen. It varied from 2½ to 3 feet in thickness, however, and was called the "Three Foot" or "Sulphur Vein," on account of its impurities.

Just below this a short distance the Darlington coal is mined in the hill opposite Glasgow, and there we get the following section of 177′: (Fig. 246.)

1. Massive Sandstone, Freeport,			40′
2. Sandy Shales,			30′
3. *Coal*, Darlington,	1. Coal,	1′ 7″	2′
	2 Slate,	1″ to 2″	
	3. Coal,	3″	
4. Fire Clay, seen,			5′
5. Concealed to the Ohio River,			100′

Here this coal, although so thin, is mined quite extensively by Mr. Udick, and supplies the villages and country in the vicinity The 3″ bench is seldom used, as it is sulphurous and impure. The upper bench of the coal is remarkably pure, being preferred to the Pittsburg for many purposes, and especially smithing. It is a black shining coal, richly bituminous, and comes out in large, handsome blocks

The Little Beaver, Ohio Line, long Section of 337½′.

Near the Ohio line, on Little Beaver creek, we see the following section, in descending the steep hill side on the right bank of Little Beaver 337½′: (Fig. 247.)

1. Massive Sandstone, Mahoning, . (Conglomerate)	60′
2. Concealed,	10′
3. Sandy Shales,	35′
4. Dark Shales, containing nodules of Iron Ore,	3′
5 *Lower Freeport* Coal, impure,	0′ 10″
6 Sandy Shales,	20′
7. Massive Sandstone, Freeport,	50′
8. Sandy Shales,	35′
9. *Coal*, Darlington,	2′
10. Fire Clay,	5′
11. Shales, containing nodules of Iron Ore,	15′
12. *Coal*, Kittanning,	2′ 6″
13. Fire Clay,	10′

14.	Sandy Shales and Shaly Sandstone,	50′
15.	*Limestone*, Ferriferous,	1′
16.	Blueish Sandy Shales,	8
17.	Dark Bituminous Shale, containing Iron Ore, bedded in its top,	5′
18.	Sandstone, somewhat Shaly,	15′
19.	Shales, Sandy at the top, but dark and Bituminous below, and extending to the bed of Little Beaver,	10′
20.	Massive white Sandstone, Piedmont, in bed of Little Beaver.	

The Upper Freeport coal, if present here, is in the concealed interval, No. 2, and nothing was seen of it; very probably it is not present at all, for the Mahoning Sandstone is unusually coarse and conglomeratic, and the coal may have been eroded.

The Ferriferous Limestone here again makes its appearance after having been concealed under the terrace deposits at every point between this and Industry, five miles above. It is rather impure and shows the "*cone-in-cone*" structure, as usual when thin. In it were seen *Chonetes mesoloba*, *Spirifer cameratus* and *Productus longispinus*

The top of the *Piedmont Sandstone* is seen in the bed of Little Beaver, and a few rods above, it rises above the surface, and is seen to be a very hard, coarse, white sandstone, over which the water runs in a rapid fall, and has cut and channeled it into all sorts of shapes.

Passing up Dry run, which puts into the Ohio at Smith's ferry, the bed of the stream rises rapidly, and the Kittanning and Darlington coals soon pass under.

The walls of this stream are almost vertical, since the *Freeport Sandstone* is very massive along its course, and over 100 feet thick.

At the forks of the stream, two miles above its mouth, the *Upper Freeport coal* was mined on the land of Mr. Gorle. But being only two feet thick, has been abandoned. This coal runs under McLaughlin's run, a short distance above where that stream unites with Dry run.

On the branch of Island run, which comes down from Ohioville, the Upper Freeport coal is mined one half mile south from that village, by Mr. Dawson, at whose bank we see the following section of 44′: (Fig 248.)

1. Massive Sandstone, Mahoning,			20′
2. Shales,			4′
3. *Coal*, Upper Freeport,	1. Semi-Cannel,	6″	4′
	2. Coal,	2′ 6″	
	3 Slate,	½″	
	4 Coal,	3′ 0″	
	5. Slate,	0′ ½″	
	6. Coal,	0′ 8″	
4. Fire Clay and Shales,			4′
5. *Limestone*, Freeport,			2′
6. Concealed to the run,			10′

The coal is very good, coming out in large clean blocks, and showing only a small quantity of pyrites. The top layer is a *semi-cannel.*

The [*Upper*] *Freeport Limestone*, below the coal, is very hard and compact. The dip is here very rapid to the south, as the coal falls at least 150 feet per mile for some distance along this stream.

The same coal is mined on the opposite side of the stream, by Mr. Watts, and there exhibits the same section as is seen at Dawson's.

Mr. Lyon also has a bank in the same coal, one fourth of a mile east from this, on another branch of the stream.

One mile west from Fairview, the *Upper Freeport coal* passes under Island run, a short distance below the "five points," or forks of the road. It has been mined there on the land of Mr. Cheeny, but is only two feet thick at the mouth of the drift.

Coal bed erosion in the Carboniferous Age.

Just below it a few rods the coal has entirely disappeared, and in its place we see a conglomerate mass of worn and rounded pieces of limestone, coal, slate, sandstone, pebbles, &c., showing that the coal has there been torn away, as also the limestone below it, and the fragments *redeposited by some ancient turbulent current of the carboniferous era.*

Descending this run, it falls very rapidly, and the coal is soon carried far above it.

The coal was once mined below the road, which passes down this run from Ohioville, at a height of 120 feet above the stream. There it is reported to have been three to four feet thick.

The Darlington coal makes its appearance above water-level, and 140 feet below the Upper Freeport, where the Ohioville road comes down to Island run. It has been mined here to supply fuel for the oil wells, and is two feet thick.

The Kittanning coal comes out of the stream a short distance below, and has also been mined; but there are no banks in operation on it now. It is reported 2½ to 3 feet thick.

The Darlington coal is opened a short distance above the Ohio line by Mr. Amos Dawson.

The Upper Freeport coal thins away on Bealer's Run, as several openings made for it at the horizon of the limestone failed to find any workable coal Below its horizon 60 feet the Lower Freeport coal was once mined near school-house No. 9, but everything is covered up and fallen in, so that nothing could be learned of it.

Coming down Bealer's run, the stream soon cuts down through the *Freeport sandstone*, which is there *130 feet thick*, and rising in massive vertical walls on either side of the stream, makes a scene of the wildest grandeur.

The Darlington coal goes under this stream just before the Ohio line is reached. Returning and passing up to the high ground, we come into the Lower Barrens, and the blossom of the *Brush Creek coal* is frequently seen. One and a half miles above the mouth of Bealer's run, the Upper Freeport coal goes under the stream, and is there mined by Mr. Arms, where it is 3 feet thick, and a tolerably fair coal.

Description of the Smith's Ferry Oil Field

Perhaps the most interesting part of Ohio township is that pertaining to its oil, since what is known as the Smith's Ferry Oil Territory is located almost entirely within this township.

Long before any borings were made here, oil would ooze out on the Ohio river, and was collected by cloths, and was called "Seneca oil." It still continues to float out on the surface of the water along the Ohio.

The first well was bored by Messrs. Pattens, Finlens,

[illegible]

Swan & Co., who, in December 1860, obtained some oil at 180 feet.

In the February following, the Excelsior Company struck a heavy oil at a depth of 72 feet, only a few feet below the level of the Ohio, and in the Piedmont Sandstone, which is seen in the bed of the Little Beaver above its mouth, and along the Ohio at low water, one mile above Smith's Ferry.

This well obtained 400 barrels of 29° oil, when it was completely exhausted. By this time, the excitement had become intense, wells were bored in every direction, and the territory was rapidly developed

It also became known that the *productive* oil-rock was to be sought from 700 to 730 feet below the Kittanning coal, or about 600 feet below the bed of the Ohio at Smith's Ferry.

Out of the hundreds of wells that have been drilled here, I was enabled to obtain the regularly kept record of only one; and this record was for only part of the distance down to the oil rock.

Smith's Ferry Oil Well Record of 478½'.

One of these wells was commenced near the level of the Ohio, and shows the following, commencing 100 feet below the Kittanning coal, or immediately upon the Piedmont Sandstone 478½': (Fig. 249.)

1. Conductor hole,	Conglomerate Series. (Beaver River Group.)	5'
2. White Sandstone, Piedmont (some Oil),		15'
3. Black Slate,		2' 4''
4. Gray Sandstone (Oil show),		4'
5. Black Slate (Gas),		1' 8''
6. Fire Clay,		2' 8''
7. Gray and white Sandstone,		25' 6''
8. Black Rock, hard,		15'
9. Fire Clay and Shales,		5'
10. Black Slate (Gas),		6'
11. Shale (Gas and Oil),		18'
12. *Coal*,		1'
13. Fire Clay,		10'
14. Slate and Shale,		25'
15. Hard white Sandstone,		61'
16. Black Shale,		10'
17. Fine-grained Sandstone,		19'
18. Shaly Sandstone,		49'
19. Hard white Sandstone,		16'

20. Shale,	2′
21. Hard Sandstone,	8′
22 Shales,	17′
23. Hard white Sandstone,	6′
24. Shales (Salt-water and Oil),	40′
25. Hard Sand,	5′
26. Slate,	7′
27 Sandstone (Salt-water and Oil),	23′
28 Slate (Oil),	28′
29. Sand,	5′
30. Shale,	2′
31. Hard Sandstone (strong Salt-water),	20′
32. Slate,	17′
33 Sand (much Gas and Salt),	6′
34. Hard Sand Rock,	7′

No 15 is probably the bottom of the Conglomerate Series, while No. 2 is the top.

Map of the Field.

The accompanying *map of the region*, will show the areas of development. They will be seen to lie in the vicinity of Smith's Ferry, and on Dry run and its tributaries, and along Little Beaver and Island run.

The oil comes in the first sand of the Butler county oil region.

The wells are all small, none ever having exceeded 25 barrels per day, until March, 1877, when a 50 barrel well was struck near Ohioville, by Mr. Smith The wells soon fall off to one and two barrels per day. The place of greatest excitement now is the vicinity of Ohioville, where the 50 barrel well was lately struck.

The Ohioville 50 barrel Oil-well, March, 1877.

This well commences 75 feet above the Upper Freeport coal, and the oil is obtained at 975 feet. The driller gave me the following record of the well from memory, and as many drillers tell about the same story respecting the neighboring wells, the *tradition* may be considered correct in a general way: (Fig. 250.)

1. Conductor hole,	8′
2. Shales,	27′
3 Massive Sandstone, Mahoning,	40′
4. Shales,	50′
5. "Buttermilk Sandstone" (Freeport),	95′
6. Shales and Sandstone,	250′

7. "Mud-vein" Sandstone,	40′
8. Shales,	20′
9. Hard white Sandstone,	15′
10. Shales,	25′
11. Very hard white Sandstone ("Glass Sand") (XII),	40′
12. Shales and soft Rocks (Cuyahoga and Berea,)	280′
13. "Blue Rock" hard Sandstone,	50′
14. Slate,	20′
15. Very hard Sandstone ("Gray Rock"),	10′
16. "Oil-rock," white, pebbly Sandstone,	28′
Total as summed up,	998′

Here the entire Lower Coal Series was passed through without a single coal being noted by the driller.

The Upper Freeport coal is seen only one half mile south, 4 feet thick, yet even it was unnoticed.

The Freeport Sandstone, No, 5, is termed the "Buttermilk," from the peculiar grayish-white sand that comes up in the pump in passing through it.

No. 11 is doubtless the bottom member of the Conglomerate Series, and is called the "Glass Sand" by the drillers, from its being so hard and white.

No. 12 represents the Cuyahoga Shale and Berea Grit of Ohio.

Butler and Venango Second and Third Oil Sand absent. Some wells along the Ohio river have been drilled to a depth of 500 feet below this oil-bearing rock, but no oil was obtained below it, as the lower oil sands of Butler county have here fined down into shales and fine-grained sandstones, incapable of holding any oil

All the oil obtained is a light, yellowish, amber color, and from 48 to 52 gravity. It is a beautiful, clear fluid, and is almost universally burned in a crude state by the people of the vicinity, in the ordinary glass-lamp. No accidents have ever occurred from thus using it, from which it would seem not to possess the more volatile hydro-carbons to any extent. It makes a tolerably fair bright light, if the fluid has not been exposed to the air too long.

There are about two hundred wells in the district, from which oil is now obtained, but many of them yield only four to five barrels per month, and are not pumped, as the gas, which always accompanies the oil, is in sufficient quantity to force up all the oil that accumulates. Others again are pumped only a few minutes a day until the head of oil is exhausted. Previous to the strike at the 50-barrel well, the estimated production of the district was one hundred barrels per day, and the railroad agent, Mr. William Smith, from data obtained on the books of the company, places the annual production at 35,000 barrels.

The oil is refined in the vicinity, and very little crude oil is shipped from the district.

The producing area is now confined almost entirely to this township, as only a small quantity of oil is now obtained on the Little Beaver, in Ohio.

CHAPTER IX

Analyses of Coal, Cannel, Coke, Clay, Limestone, and Ore, from Butler and Beaver Counties, Pa. By Andrew S. McCreath, Chemist in charge of the Laboratory at Harrisburg.

BRUSH CREEK COAL.

1. Butler Co., Connoquenessing T., Cable's Mine; 5 miles N. E. of Harmony, on the Little Connoquenessing Creek. See page 123 Q.

Luster generally resinous; strongly iridescent; partings of pyrites unusually numerous in the specimens received.

2 Butler Co., Connoquenessing T., Wilson's Mine; at mouth of Semiconon Creek, 2 miles E. of Whitestown. See page 125 Q.

Luster bright, resinous, generally; somewhat iridescent; conchoidal fracture; considerable mineral charcoal and pyrites.

	I.	II
Water,	1.740	1 600
Volatile matters,	42 450	43 860
Fixed Carbon,	45 551	47 415
Sulphur,	4 104	2 700
Ash,	6.155	4.525
	100 000	100 000
Coke,	55 81	54 64
Color of ash,	deep pink.	grey, with pink tinge.

LOWER FREEPORT COAL.

3. Butler Co., Jackson T., Schantz's mine, near Ziegler's mill, 1½ miles E. of Harmony. See page 114 Q.

Appearance bright, pitchy; generally compact; numerous partings of mineral charcoal; considerable pyrites in scales.

	III.
Water,	2 290
Volatile matters,	33 580
Fixed Carbon,	55 772
Sulphur,	1 158
Ash,	7 200
	100 000
Coke,	64 130
Color of ash,	grey

DARLINGTON COAL.

(*Upper Kittanning Coal.*)

IV. Butler Co., Jackson T., Fiedler's Mine; near Ziegler's Mill, 1 mile E. of Harmony. See pages 115, 116, Q.

Generally compact; seamed with bright pitchy looking coal; carries considerable mineral charcoal and pyrites.

V. Butler Co., Lancaster T., Melvin's Mine; on West branch Yellow Cr., 3½ miles S. E. from Portersville. See p. 118 Q.

Appearance fatty; numerous thin bands of bright crystalline coal; generally compact and clean looking, but shows considerable pyrites.

VI. Butler Co., Lancaster T., Beaver's Mine; 1½ miles above the mouth of Yellow Creek.

Somewhat slaty; luster bright, resinous; seams of bright crystalline coal run through it.

	IV.	V.	VI
Water,	1 390	1 455	1 300
Vol. matters,	41 265	43 250	40 220
Fixed Carbon,	48 029	49 716	42 661
Sulphur,	3.681	2 109	2 404
Ash,	5 715	3 470	13 415
	100,000	100 000	100 000
Coke,	57 345	55 295	58 480
Color of ash,	pink.	reddish grey.	reddish grey.

VII. Beaver Co., North Sewickley T., Dougherty's Mine; 3 miles north of New Brighton. See page 207, Q.

Coal compact; seems unusually free from slate and pyrites, only a few specks being visible; has generally a bright, shining luster.

VIII. Beaver Co., Darlington T., Mansfield's Mines, near Cannelton, 3 miles south from Darlington. 232 Q.

Compact; luster bright, shining; specimens received carry an unusual amount of thin partings of pyrites.

IX Beaver Co., N. Brighton T., Middleton's Mine; on Brady's run, 1 mile west from New Brighton. 251 Q.

The Coal (specimens received) has a dull luster generally, being considerably coated with a yellowish white silt; rather tender, and carries considerable mineral charcoal and pyrites.

	VII.	VIII.	IX.
Water,	3 090	1 780	2 680
Vol. matters,	37 915	40 760	36 205
Fixed Carbon,	56 980	49 391	53 804
Sulphur,	495	3 379	2 391
Ash,	1 520	4.690	4 920
	100 000	100 000	100 000
Coke,	58 995	57.460	61 115
Color of ash,	cream.	grey, red tinge.	reddish grey.

DARLINGTON CANNEL.

X. Beaver Co., Darlington T., J. F. Mansfield's Mine, near Cannelton, 3 miles S. of Darlington. See page 232 Q.

Compact; fracture conchoidal; lustre dull; carries very thin seams of bright crystalline coal.

	X.
Water,	1.160
Vol. matters,	48 015
Fixed Carbon,	38 241
Sulphur,	.599
Ash,	11.985
	100 000
Coke,	51.985
Color of ash,	grey.

KITTANNING COAL.

(*Lower Kittanning Coal.*)

XI Beaver Co., Rochester T., Fell's drift, at Rochester.* See page 196 Q.—Bench not stated.

Coal, of dull resinous appearance generally, shows numerous thin partings of slate and iron pyrites.

XII. Beaver Co., Patterson T., Ross & Smith's Mines, near Beaver Falls. See page 247 Q.—Bench not stated

Coal, of resinous luster generally, carries numerous thin bands of bright crystalline coal. Shows some slate partings and considerable pyrites.

	XI.*	XII.
Water,	1 450	1 620
Vol matter,	34 270	39 385
Fixed Carbon,	36 193	43 603
Sulphur,	3 357	2 822
Ash.	24 730	12 570
	100 000	100 000
Coke,	64 280	58 995
Color of ash,	grey, pink tinge.	dirty grey, pink tinge.

Upper Bench.

XIII. Beaver Co., Pulaski T., Mendenhall & Chamberlin's Mines, near New Brighton. See page 194 Q.

Coal, bright, compact, carries an unusually large number of thin partings of iron pyrites.

XIV. Beaver Co., Pulaski T., Couch's mine, near New Brighton. See page 196 Q.

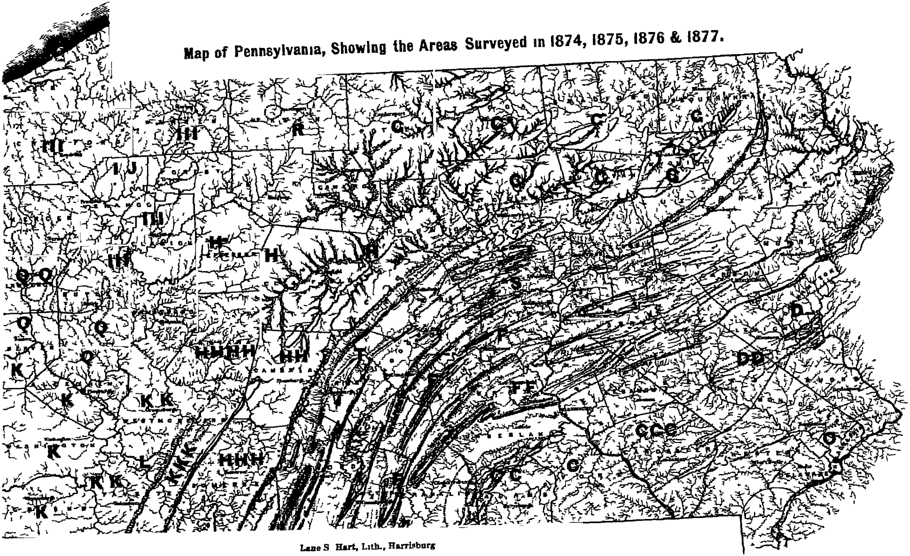
Coal, generally compact, has a bright, resinous luster; carries numerous thin partings of pyrites.

XV Beaver Co., Patterson T., Hulmes' mines, near Beaver Falls. See page 247 Q.

---

* This analysis is given to illustrate the rapid deterioration of the Kittanning Coal bed, when followed southward from New Brighton to the Ohio River

Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876 & 1877.



Lane S Hart, Lith., Harrisburg

KITTANNING COKE.

Lower Bench.

XX Beaver Co., Patterson T., Hulmes' Coke Ovens, Beaver Falls. See page 247 Q.

This Coke is generally very compact, of bright, silvery luster, and carries small particles of intermingled slate.

	XX.
Water,	0 010
Volatile Matter,	0 083
Fixed Carbon,	84 727
Sulphur,	1 994
Ash,	12 636
	100 000
Color of ash,	red.

KITTANNING UNDER CLAY.

XXI Beaver Co., Rochester T., S. Barnes & Co 's fire brick-works, near Bridgewater, 1 m. N. from Rochester.

Contains a little Manganese.

Analysed by D. McCreath (Alumina in duplicate analysis by A. S McCreath=23.760.)

XXII Beaver Co., Pulaski T., Mendenhall & Chamberlin's Mines near New Brighton

Analysed by David McCreath

XXIII. Beaver Co., Pulaski T., Elverson & Sherwood's Mines near New Brighton.

Analysed by D. McCreath.

	XXI.	XXII.	XXIII
Silica,	61.980	66 610	62 260
Alumina,	23.880	18 390	23 890
Protoxide of Iron,	1.395	1 964	1 408
Titanic Acid,	1 830	2 810	1 780
Lime,	040	.490	470
Magnesia,	281	.547	309
Alkalies,	1.217	1.079	1 977
Water, hygroscopic,	1.460	7 495	7 640
Water, combined,	7.820		
	99.903	99.385	99.734

XXIV. Beaver Co , Pulaski T., Elverson and Sherwood's Terracotta-works, near New Brighton. 195 Q

Grade of Clay No. 1. Specimen consisted of a moderately soft rounded ball of a pearl gray color, with a somewhat gritty feel, but apparently in the main free from impurity. (Duplicate analysis of Titanic acid =1.920.)

XXV. Grade of Clay No. 2. Specimen similar to the last. Analysed by D McCreath.

XXVI. Grade of Clay No 3. Specimen similar to the last. (Duplicate analysis Titanic acid =1 810.)

	XXIV.	XXV	XXVI.
Silica,	61 970	61 750	62 890
Alumina,	22 940	23 660	21 490
Protoxide of Iron,	1 818	1 930	1 818
Titanic Acid,	1 975	1 780	1.825
Lime,	440	455	380
Magnesia,	522	353	569
Alkalies,	1 750	2 418	2 525
Water, hygroscopic,	1 480	680	1 160
Water, combined,	7 370	7 200	7 580
	100 265	100 226	100.237
Sand,	34 250		35 510
Silica in sand,	34 180		35 100

XXVII. Beaver Co.. Pulaski T , from land of Mr. Coale, near New Brighton. See page 196 Q. (D. McCreath)

XXVIII. Beaver Co., Pulaski T , Couch's drift, near New Brighton. See page 196 Q. (D. McCreath.)

XXIX. Beaver Co., New Brighton T., Severn's Mine, near Vanporte, on the Ohio river. See page 251 Q

The clay is very brittle, and moderately soft, breaking up readily in the hand; has a pearl gray color and somewhat unctuous appearance. Analysed by D. McCreath

	XXVII.	XXVIII.	XXIX.
Silica,	56.670	57 670	60.190
Alumina,	26.560	27 520	24.230
Protoxide of Iron,	2.106	1 494	2 097
Titanic Acid,	1 790	2 540	2 845
Lime,	.260	380	.850
Magnesia,	277	122	036
Alkalies,	3 790	619	1 669
Water,	8 360	9 680	9 015
	99 813	100 025	100 482

FOURTH TERRACE CLAY.

XXX. Beaver Co., Pulaski T., near New Brighton, taken from the surface of the Fourth Terrace, (counting upward from the bed of the Ohio River,) on the land of Mendenhall & Chamberlin.

Analysed by D. McCreath.

XXXI. The same at New Brighton, and used by Elverson & Sherwood in their manufacture of plant pots.

Analysed by D McCreath.

	XXX.	XXXI.
Silica,	46 160	67 780
Alumina,	26 976	16 290
Sesquioxide of iron,	7 214	4 570
Titanic Acid,	740	780
Lime,	2 210	600
Magnesia,	1 520	727
Alkalies,	3 246	2 001
Water,	11 220	6 340
	99 286	99 088

FERRIFEROUS LIMESTONE.

(*Below the Kittanning Coal.*)

XXXII. *Top Stratum.*—Beaver Co., New Brighton T , Power's Quarries, near Vanport, on Ohio river.

Compact; very brittle , fracture irregular; color dull gray and reddish gray. See page 251 Q.

XXXIII. *Upper Bench.*—Severn's Quarries, ½ m. below Vanport. See page 251 Q.

Specimens exceedingly brittle, with irregular fracture; color generally reddish gray.

XXXIV. *Middle Stratum.*—Powers' Quarries.

Specimens compact and tough; sparkling with calcite; spotted with pyrites; color pearl gray and reddish gray See page 251 Q.

XXXV. *Lower Stratum.*—Tygart's Quarries, ½ m. below Vanporte.

Specimens hard and brittle; fracture irregular, sparkling with calcite; color bluish gray and reddish gray.

Analysed by D McCreath, (the other three by A. S. McCreath.)

	XXXII.	XXXIII	XXXIV.	XXXV.
Carbonate of Lime,	88 464	93 482	91 607	91 089
Carbonate of Magnesia,	1 445	1 544	1 566	1 587
Oxide of Iron and Alumina,	2 824	1 823	1 291	1 589
Sulphur,	097	030	290	040
Phosphorus,	029	047	030	047
Insoluble residue,	7 030	2 770	4 780	4 800
	99.889	99.696	99 564	99 152

IRON ORE

(Sixty feet below U. Freeport Coal.)

XXXVI. Butler Co., Winfield T., near Denny's Mill, 1½ m. W. from old Winfield Furnace See page 92 Q.

Carbonate ore considerably oxidized, reddish brown.

Analysed by D. McCreath.

	XXXVI.		
Protoxide of Iron,	34 200	Iron,	34 50
Sesquioxde of Iron,	11 285		
Alumina,	4 326		
Lime,	4 720		
Magnesia,	2 854		
Sulphuric Acid,	120	Sulphur,	048
Phosphoric Acid,	849	Phosphorus,	371
Carbonic Acid,	28 670		
Water,	2.500		
Insoluble residue,	10.765		
	100 289		

A.—GENERAL INDEX TO Q.

Page.

Alethopteris—see Fossil plants.
Alluvion, 200′ deep—see erosion, 15,16
"Alum rocks" at New Brighton, 249
Analyses—see clay, 4,13,14,17,241,13,46
Ancient river bed—see erosion.
Annularia—see fossil plants.
Antholithes—see fossil plants.
Anticlinals and synclinals of the district. Chap. III., 19
Anticlinal of Brady's Bend ("Fifth Axis"), 19,57,82
  in Clinton T.; crosses Bull Cr., 85,86,87
  in Winfield T.; below Saxon city, 91,97
  in W. Deer T., 150,151
  in Shaler T., crest on Pine Cr., 156
  in Hampton T., crosses Gourdhead run and Pine Cr., 160,161
  crosses Ohio river at Wood's run, 165
  in Ross T., carries a knob of Pittsburgh C., 166
  crosses Girtie's run at the forks, 167
Anticlinal (local) on Bull's Cr., 22
Anticlinal (local) Big Bull Cr., Fawn T., 144
Anticlinal (local) on the Beaver river at Homewood, 22
Anticlinal (local) on Buffalo Cr., 91
Anticlinal (local) across Summit T., 132
Artisia—see fossil plants.
Astarte—see fossil shells.
Astartella—see fossil shells.
Asterophyllites—see fossil plants.
Athyris—see fossil shells.
Aviculo-pecten—see fossil shells.
Aviculo-pinna—see fossil shells.
Bakerstown Coal bed described—see geological index and 81
Barren Measures—see geological indexes and 2,6,23,26
Bastard (Butler) Limestone (L. F. L.)—see geological indexes and 95,108
Beaver River Group described and section, Chap. VII., 65,66
Bellerophon—see fossil shells.
Berlin Coal bed wanting, 29
Big Knob in Beaver Co., 27
Binders of sulphur in coal beds—see coal bed, 95,192,248,252
Blacksmith Coal and Blacksmith vein—see Coal and Darlington C. in geological indexes, 52,196,217,287
Blocks of Pittsburgh SS. on high knobs in Indiana, McCandless, and Franklin T., 153,169,174
Blocks of Morgantown SS. on knob in Butler Co., 79,80
Blocks of Upper Freeport Limestone, huge, in Jordan's run, &c., 86,227
Blocks of Brush Cr. Limestone fallen into Swickley Cr., 178
Blocks of Mahoning SS., 197,218,219,239,256,260,264

Page.
Blocks of Buffalo SS. at Lardin's mill, &c., 85,89,101,103,104,109,123,135
Blocks of Upper Freeport (Butler) SS., huge, 98,130,200,204,210,244
Blocks of Ferriferous Limestone, as big as a house, 209,210
Blocks of Piedmont SS., in Rough run and Beaver River, 93,205,208
Blocks, angular and rounded, mixed with lumps of coal, &c., 228
Blocks (Erratic)—See Erratic Blocks, 10
Block Coal—See Coal, see Sharon Coal
Bluffs of Sandstone, &c.—See Cliffs
Boulders of northern rocks, floated by ice-bergs—See drift, 9,227,237
Brady's Bend anticlinal—See Anticlinal.
Brecciated Limestone—See L. F. L., see Limestone in geological indexes, 47
Brick bench of U. F. C.—See Coal, 83,140
Brick clay—See Clay, 12,46,190,192,265
Brookville Coal.—See geological indexes, 68
Brush Cr. Limestone—See geological indexes, 32
Brush Cr. Coal—See geological indexes, 35
Bryozoan—See fossil shells
Buffalo SS. described—See geological indexes, 5, 83
Buhr-stone iron ore—See iron ore, 60
Building stone, Morgantown SS., 104
Building stone, Mahoning SS.—See quarries, 37,177,182,184,186,197,246,258
Building stone, Upper Freeport SS., on Beaver river, 195
Bulls Creek Anticlinal traced—See anticlinal, 22
Buried river channels—See erosion, 14
Butler Limestone (L. F. L.) described—See geological indexes, 49
Butler Sandstone (U. F. S. S.) described, mistaken for Mahoning SS., on the Beaver—See geological indexes, 47, 48
Calamaria—See Fossil Plants, 54
Calamites—See Fossil Plants, 54
Calamostachys—See Fossil plants, 54
Callipteris—See Fossil Plants, 54
Cannel—See Coal.
Cañons of XII—See Gorges, 16
Cardiocarpus—See Fossil Plants, 55
Carpolithes—See Fossil Plants, 55
Caulopteris—See Fossil Plants, 55
Cemented Drift—See Drift, Cliff, 9
Cement bed—See Limestone, 56,222
Champlain Clay formation, 13
Chonetes—See Fossil Shells, 33
Clarion Coal and Under Clay described—See geol. indexes, 68
Clay under Upper Freeport C., analysed, 23, 46
  pure on Davis' run, Econ. T.; good in Big Beaver T., 46,183,224
Clay under Darlington C.; brick clay, 205
Clay under Kittaning C. at Freedom, on Swaney's run; on Crow's run; at Butler Street; on Whistler's run; at Terra Cotta Works; at Smith's ferry, 57,58,59; 96, 184,190,192,193,195,196,215,265
Clay of Gourd Head Run and Pine Creek; in Hampton T., 159,161
Clay under Clarion Coal, 68
Clay of the Champlain Era; and terraces, 12,13,195,229
Clay Analyses, 13, 46

Page

Clay veins—See Coal bed, 74, 78

Cliffs of Cemented Drift at mouth of Big Beaver, . . 9

of Gravel used for ballast on R R —B. B. T., . 228

Cliffs of Morgantown SS , Ohio T., Killbuck run, 176

Cliffs of Lower Barren Measures Sandstones, . 2

Cliffs of SS , 40′ above Pine Cr. L , Shaler T.; and Ross T., on Girtie's Run, 158,167

Cliffs of Buffalo SS , on Sarver's run, Little Buffalo; Winfield T ; Penn T ; immense, in Penn T , on Connoquenessing creek, Evansburg, in Forward T., in Connog. T., below mouth of Semiconon creek, immense in Butler T., on Butcher's run (all in Butler Co.), . 38, 89, 96, 97, 100,101; 104, 108; 128, 124, 125, 127, 127, 128

Cliffs of Buffalo SS. in Fawn T ; on L Pine Cr., Shaler T., 90′ high on Pine Cr , Hampton T ; in Ohio T.; on Killbuck Cr , (all in Alleghany county), 141; 158, 160, 161; 175, 176

Cliffs of Buffalo SS in Economy T , on Crow's run ; on hill top over mouth of Soap run, Franklin T. (in Beaver County), 180; 219, 220

Cliffs of Brush Cr Lime, R. R Summit, B B. T., 226

Cliffs of Mahoning SS., on Buffalo Creek, on Pine Cr , Shaler T , and Sewickley T., mouth of Sewickley Cr. (All Co.), 2, 87, 88, 156, 178

Cliffs of Mahoning SS , on Crow's run, New Sew. T., branches of Block House run, Pulaski T ; over Beaver Falls, hill top; on Brush run, North Sew. T.; on Broad run, Jordan's run, Big Beaver T.; Little Beaver river, S Beaver T.; South of New Lisbon road, Brighton T ; at Industry, 80′ at Smith's Ferry, Ohio T. (all in Beaver Co), 187 , 197, 202; 212; 214, 227; 239, 257, 200, 264

Cliffs of U. F. (Freeport) L. below New Galilee, B. B T., . 229

Cliffs of Butler SS. (U. F. SS.) on Trough run, Pulaski T.; over Beaver Falls, Coarse Conglomerate, 200,202

Cliffs of Freeport S. S. (L. F. SS.) at Evans' Mill, Forward T.; on Crow's run resting on Darlington Coal, Economy T.; Crow's run, New Sew. T., on Trough run, Pulaski T , forks of Bennet's run, N Sew T., overhanging cliffs of Soap run, Franklin T., immense on Brady's run, Chip T. and Brighton T.; on Two-mile run, above Vanporte; 120′ vertical below Industry, 180′ at Smith's Ferry, and on Bealers run, . 109, 185, 186, 200, 207; 220; 243, 258; 256, 262, 264; 269

Cliffs of Kittanning SS. massive, on Six Mile run, Industry T., Beaver Co., ... 259

Cliffs of Trough run with Clarion coal, . . . 201

Cliffs of Ferriferous Limestone, where it is most massive (up to 23′ thick) on Rough run, Winfield T.; Buffalo Cr., Clearfield T. (Butler Co.); at Hazen's bridge, and Bend of the Conoquenessing Creek, North Sew. T., 92, 93, 139, 199; 209, 210

Cliffs of Piedmont (Homewood) SS. on the Big Beaver river; above Beaver Falls, on Bennett's run, N. Sew. T ; 150′ at Homewood, N. Sew. T. (Beaver County), ... 4; 203; 205; 206; 208

Cliffs of Pottsville (Connoquenessing) SS. (No. XII.), . 209

"Coal Hill" in West Deer T., All. Co., holds Pitts. C., . 150

Coal bed under the Morgantown SS.—see geol. indexes, . 27

Coal bed (local) over Pine Cr. L.—see geol. indexes, . . 32

Coal bed 140′ above U. F. C. Two mile run—see geol. ind , . . 257

Page

Blocks of Buffalo SS at Lardin's mill, &c, 85,89,101,103,104,109,123,135
Blocks of Upper Freeport (Butler) SS, huge, 93,130,200,204,210,244
Blocks of Ferriferous Limestone, as big as a house, 209,210
Blocks of Piedmont SS, in Rough run and Beaver River, 93,205,208
Blocks, angular and rounded, mixed with lumps of coal, &c, 228
Blocks (Erratic)—See Erratic Blocks, 10
Block Coal—See Coal, see Sharon Coal.
Bluffs of Sandstone, &c—See Cliffs.
Boulders of northern rocks, floated by ice-bergs—See drift, 9,227,237
Brady's Bend anticlinal—See Anticlinal.
Brecciated Limestone—See L. F. L.; see Limestone in geological indexes, 47
Brick bench of U F. C.—See Coal, 83,149
Brick clay—See Clay, 12,46,190,192,265
Brookville Coal.—See geological indexes, 63
Brush Cr Limestone—See geological indexes, 32
Brush Cr. Coal—See geological indexes, 35
Bryozoan—See fossil shells
Buffalo SS. described—See geological indexes, 5, 33
Buhr-stone iron ore—See iron ore, 60
Building stone, Morgantown SS, 164
Building stone, Mahoning SS.—See quarries, 37,177,182,184,186,197,246,258
Building stone, Upper Freeport SS, on Beaver river, 195
Bulls Creek Anticlinal traced—See anticlinal, 22
Buried river channels—See erosion, 14
Butler Limestone (L F. L) described—See geological indexes, 49
Butler Sandstone (U F S S.) described, mistaken for Mahoning SS.,
    on the Beaver—See geological indexes, 47, 48
Calamaria—See Fossil Plants, 54
Calamites—See Fossil Plants, 54
Calamostachys—See Fossil plants, 54
Callipteris—See Fossil Plants, 54
Cannel—See Coal
Cañons of XII—See Gorges, 16
Cardiocarpus—See Fossil Plants, 55
Carpolithes—See Fossil Plants, 55
Caulopteris—See Fossil Plants, 55
Cemented Drift—See Drift, Cliff, 9
Cement bed—See Limestone, 56,232
Champlain Clay formation, 13
Chonetes—See Fossil Shells, 33
Clarion Coal and Under Clay described—See geol. indexes, 63
Clay under Upper Freeport C, analysed, 28, 46
    pure on Davis' run, Econ T., good in Big Beaver T, 46,183,224
Clay under Darlington C., brick clay, 265
Clay under Kittaning C at Freedom, on Swaney's run; on Crow's
    run, at Butler Street; on Whistler's run; at Terra Cotta
    Works, at Smith's ferry, 57,58,59,96,184,190,192,193,195,196,215,265
Clay of Gourd Head Run and Pine Creek, in Hampton T, 159,161
Clay under Clarion Coal, 63
Clay of the Champlain Era; and terraces, 12,13,195,229
Clay Analyses, 13, 46

Page
Clay veins—See Coal bed, . 74, 78
Cliffs of Cemented Drift at mouth of Big Beaver, 9
of Gravel used for ballast on R R—B. B. T., 228
Cliffs of Morgantown SS, Ohio T, Killbuck run, 176
Cliffs of Lower Barren Measures Sandstones, 2
Cliffs of SS., 40′ above Pine Cr. L., Shaler T.; and Ross T., on Girtie's Run, . 158,167
Cliffs of Buffalo SS., on Sarver's run, Little Buffalo, Winfield T; Penn T., immense, in Penn T., on Connoquenessing creek, Evansburg, in Forward T; in Connog. T., below mouth of Semicoonon creek, immense in Butler T.; on Butcher's run (all in Butler Co), 33, 89, 96; 97; 100, 101, 104, 108; 123, 124, 125, 127, 127, 128
Cliffs of Buffalo SS in Fawn T; on L. Pine Cr., Shaler T, 90′ high on Pine Cr, Hampton T, in Ohio T., on Killbuck Cr; (all in Alleghany county), 141, 158; 160, 161, 175; 176
Cliffs of Buffalo SS. in Economy T., on Crow's run, on hill top over mouth of Soap run, Franklin T. (in Beaver County), 180; 219; 220
Cliffs of Brush Cr Lime, R R. Summit, B. B T, 226
Cliffs of Mahoning SS., on Buffalo Creek; on Pine Cr, Shaler T, and Sewickley T., mouth of Sewickley Cr. (All Co), 2, 37, 38, 156; 178
Cliffs of Mahoning SS., on Crow's run, New Sew T, branches of Block House run, Pulaski T., over Beaver Falls, hill top; on Brush run, North Sew. T., on Broad run; Jordan's run, Big Beaver T.; Little Beaver river, S Beaver T., South of New Lisbon road, Brighton T.; at Industry; 80′ at Smith's Ferry, Ohio T. (all in Beaver Co), 187, 197, 202, 212, 214, 227, 239, 257, 260, 264
Cliffs of U. F. (Freeport) L. below New Galilee, B B. T, 229
Cliffs of Butler SS (U. F SS.) on Trough run, Pulaski T., over Beaver Falls, Coarse Conglomerate, . 200,202
Cliffs of Freeport S. S. (L. F. SS) at Evans' Mill, Forward T., on Crow's run resting on Darlington Coal, Economy T; Crow's run, New Sew. T., on Trough run, Pulaski T, forks of Bennet's run, N. Sew. T, overhanging cliffs of Soap run, Franklin T; immense on Brady's run, Chip. T. and Brighton T, on Two-mile run, above Vanporte; 120′ vertical below Industry, 130′ at Smith's Ferry, and on Bealers run, 109, 185; 186, 200; 207; 220, 243, 253; 256, 262, 264; 269
Cliffs of Kittanning SS massive, on Six Mile run, Industry T., Beaver Co., . . 259
Cliffs of Trough run with Clarion coal, . 201
Cliffs of Ferriferous Limestone, where it is most massive (up to 23′ thick) on Rough run, Winfield T., Buffalo Cr., Clearfield T. (Butler Co.); at Hazen's bridge, and Bend of the Conoquenessing Creek, North Sew. T, 92, 93; 130; 199; 209, 210
Cliffs of Piedmont (Homewood) SS on the Big Beaver river; above Beaver Falls, on Bennett's run, N Sew. T., 150′ at Homewood, N. Sew T (Beaver County), . 4, 203; 205; 206; 208
Cliffs of Pottsville (Connoquenessing) SS (No. XII.), . 209
"Coal Hill" in West Deer T, All. Co, holds Pitts. C., 150
Coal bed under the Morgantown SS.—see geol indexes, 27
Coal bed (local) over Pine Cr L.—see geol indexes, . 32
Coal bed 140′ above U F. C Two mile run—see geol. ind., . . 257

Page.
Coal No VII, Ohio Survey, Brush Creek—see geo. index., 35
Coal bed in the heart of the Mahoning SS—see geol. index, 106
Coal beds (two) in Mah SS., Forward T—see geol index, 107
Coalbed commenced, but not finished, U. F. C, Fawn T, 143
Coal No. VI, Ohio Survey, U F. C (E)—see geol. index, 43
Coal No. V., of Ohio Survey, L F C. (D)—see geol index, 48
Coal No. IV, Ohio Survey, Darlington C—see geol. index, 53
Coalbed under the Mercer Limestone—see geol. ind, 60
Coal beds passed unnoticed by the well sinkers, 272
Coal (*Blacksmith* Vein) Darlington C, 52,196,217,237
Coal (*Cannel* and semi-cannel) origin of, 53
  in top layer of Pittsburgh Bed, W. Deer T., All Co., 150
  in Elk Lick bed, near Alleghany City, Wood's run, Reserve T, All Co, and in Aikin mine, Franklin T., . 28,164,165,172
  in Bakerstown C bed, to bottom bench, top bench, in Middlesex T., But. Co.; at bottom, Richland T, All Co, 32,79; 163
  in Brush Cr C bed, often; Economy T, shale roof, on Brush Creek, N. Sew. T., . 36,181; 213
  in Mahoning SS, 106
  in Upper Freeport C. bed, at top, Adams T., Bt. Co, on Breakneck Cr., Forward T, top layer, E. Deer T., All Co, 75,108; 148
  in Lower Freeport C bed, 3d layer, Six-mile run, Brighton T., Trough run, Pul T, Beaver C, 114,115; 200; 258
  in Lower Freeport SS, on Beaver River, 50
  in Eichenhauer's mines, Lancaster T., Bt. Co., 121
  in local coal bed over Darlington C, Pul T, Bea. Co., 202
  in Darlington C bed, described, 6', at top, New Sew. T., impure, roof, Barrisville, Marion T, on Coal run, Darl. T., on Anderson's run, S Beaver T, 53; 186, 215, 233; 238
  in Kittanning C bed, 0" to 16", bottom layer, at Industry, 260
  below the Piedmont SS (Mt Savage C bed?), . 223
  local origin of cannel illustrated at Beaver Falls, 53,202
  turns to bituminous shale, Lanc T., All Co., 121
    very irregular, . 200
    cut away by approach of roof to floor, 234
Coal (block) of Sharon Bed, 231
Coal (brick) in U. F. C good, 83, 149
Coal; rolls in Brush Cr. bed, Cranberry T., Butler Co., 74
Coal bed injured by clay-veins, Bakerstown bed; Brush Creek bed 78; 74
Coal bed injured by "Binders of Sulphur;" U F C, Swaney's run; large in Kitt C, McKinley's run, upper bench of Kitt. C, Brady's run, easily separated, 95, 192; 243; 252
Coal lumps numerous in the Gravel bed of the Cliff in Big Beaver T., 14, 228
Cobble Stone Conglomerate, Drift, . . . 9
Coke, beehive ovens; Beaver Falls, 247
Coleman Coal bed = ? Bakerstown C, . 31
Coleman Limestone = ? Pine Cr L, 32
Cone-in-cone (tutenmergal) structure in Ferrif L., Trough run, Pul. T, on Beaver R, North Sew. T, New Brighton, E. Br. Brady's run; at Ohio Line, 200, 205, 248, 250, 253, 267

Page
Conglomerate of Cobble stones in Drift, . . 9
of Buffalo SS in Penn and Winfield T. T.; 38; 96,100,101; 127
of Mahoning SS at the Ohio Line, quartz pebbles, 87; 266
of Butler SS in E Deer T., All Co, . . 147
Conglomerate of rounded limestone, coal, slate, sandstone, &c., filling an eroded portion of the Upper Freeport Coal bed, on Island run, Ohio T, Beaver Co. (See *Erosion*, ancient), . 268
Conglomerate mass of coal, iron ore, and plants, in roof of Darlington Coal bed, at Ziegler's Mill. (See *Erosion*), . 113,114
Connoquenessing SS —See Homewood; No. XII, . 65, 69
Cordaites—See Fossil Plants.
Cordianthus—See Fossil Plants
Creek Vein, popular name for Darlington Coal, ... 51
Crinoidal Limestone neglected as a fertilizer, mistaken for Elk Lick Limestone, described; (for localities, see Geological Indexes), 8; 29, 30
Crinoids—See Fossils.
Crustacean—See Fossils.
Crystalline rocks in gravel of Fifth terrace, . 12
Cyclopteris—See Fossil Plants.
D. the old designation of Lower Freeport Coal, . . . 48
Darlington (Upper Kittanning) Coal, mistaken for Kittanning Coal bed; described—(see for local details Geological Indexes), 42, 43; 51
Decline of the Brady's Bend (Fifth Axis,) 22′ per mile, . . 20
Depth of river deposits unknown—See Drift; see Erosion, 15
Dictyopteris—See Fossil Plants
Dicranophyllum—See Fossil Plants
Diluvium—See Drift; Terraces, Erosion, 15
Dip of the rocks in the district—
20′ to the mile to the South East, . . . 22
5° on the Rough run. Winfield T., But. Co., . . 93
rapid in Connoquenessing T, But. Co., ... 125
N. W. rapid on Buffalo Creek, Clearf. T., 139
on Little Bull Creek, Fawn T., All. Co., . . 142
reversed to make a synclinal, . 145
up Bull Creek, ... 146
changes, and confines the Pitts. C. area to knobs in Indiana T., 158
rapid down Pine Cr., Shaler T., ... 156
on Pine Creek, Hampton T, ... 161
100′ per mile on E. slope of Fifth Axis, on Ohio R, ... 165
of U. F. C in Ohio T,, Allegheny Co., ... 174,176
rapid up the Ohio River, Economy T., Beav. Co., . . 179
equal to water fall of Big Sewickley Creek, ... 179
rapid in Economy T., Beaver Co., ... 184
of Mahoning S. S., rapid on Crow's run, ... 187
flat on Brush Creek, New. Sew. T, . . . 188
rapid on Block House run, Pulaski T., . . 197
down Beaver River, N. Sew. T., ... 204
20′ per mile to the East on Beaver River, ... 210
up Connoquenessing Cr. to the S. E, . . . 211
strong on Island Run, Ohio Line, ... 267

Page.
Dolichopterus—see Fossils, 56
Drift, Terraces, &c. Chapter III, . 9
  cemented mass of drift forming a vertical cliff 50′ high, cobble-stones, lumps of coal, &c, . 9,14,228
  boulders of gneiss and other northern rocks, 6″ to 3′, scattered about and making a gravel bed on the Fifth terrace, 9,12,227
  boulders, floated by icebergs, all north of the Ohio River, none south of it, 237
  perched blocks on hill tops, 10
  terraces, drift in Bellevue terrace, Ohio T, 15; 175
  terraces of Ohio and Beaver rivers continuous and composed of drift material, 10,11
  terraces Nos. 1, 2, and 3 continuous, or solid, and separated from terrace No. 4 by a rock escarpment 75 feet high; also an escarpment separates No. 4 from No 5 above it, 13
  terrace No 2 on Beaver R., a mass of round polished metamorphic boulders, carries the towns of Sewickley, Phillipsburg, New Brighton, Beaver Falls, and Rochester, 11,12
  terrace No. 3 *coarser* than terrace No. 2, naked outcrop of coal measures always above 3d terrace, carries the towns of Economy, Beaver, Georgetown, and upper parts of Rochester, N. Brighton, and Beaver Falls, 11,13
  terrace No. 4 clay, used in manufacture, . 12,13
  terraces on the Connoquenessing at Harmony, 13
  terraces on the Little Beaver indistinct, 14
  terrace at Bellevue, Ohio T, All. Co., 250′ above Ohio R, 174,175
  terrace at Ballie's tavern, 120′ above Ohio River, 175
  terrace at mouth of Killbuck run, 80′ + Ohio R., 176
  terraces of the Ohio River in Sewickley T., All Co, 30′, 80′, and 120′ above the river bed, 177
  terrace at Economy Village, fine, 120′ above Ohio R., 181
  terrace of terra-cotta clay, Pulaski T, 195
  terrace gravel, curious, bed of R. R., Big Beav. T., which once filled the whole valley, . . 228
  terrace of Beaver town, 120′ + Ohio River, . . 254
  terrace at Bridgewater, 280′ to 300′ + Ohio R., . . 254
  terrace below Cook's Stat., Industry T, 120′ + Ohio, . 262
  terrace (120′ + Ohio) changes from north to south bank of Ohio river above Smith's Ferry, 263
  depth of river deposit of drift unknown, . . 15
Drift Vegetation in the roof of the Darlington coal bed, Zeigler's Mill, Jackson T., Butler Co, ... 113
E Upper Freeport Coal Bed; see Geol. Indexes, described; workable over half the district, a double bed, variable in quality and thickness, . . . 43,44,45,46
Edmondia—see Fossil Shells, . 34
Eighteen Inch Vein—see Darlington Coal bed, . . 52
Elevation above tide of erratic blocks, 1,300′, . 10
  of terraces above Ohio River, . 11,12
  of 3d terrace above Little Beaver river, ... 14
  of Big Knob, New Sew. T, Beaver Co., 1,450′ . 27

Page
Elevation, &c.—*Continued.*
of U. Freeport C. at Monroeville, But. Co., 875′, ... 89
of Pittsburgh Coal, above Ohio R, crest of Fifth axis, 600′, . 166
of Pittsburgh Coal, above tide, Pine Creek, McCandless T, 1,325′ 169
of Pittsburgh Coal, above tide, Emmit's mine, Pine T, 1,360′, . 171
of R R summit, Big Beaver T, above T., 1055′ 223
Elk Lick Coal described; wrongly placed in Report of Progress K —
for localities see Geological Indexes, 28, 34, 35
Elk Lick Limestone, variable and sporadic, 29
Emmitt's Knob, Pine T, All Co, Pittsburgh Coal bed, 22
Equisitites—see Fossil Plants, . 54
Erosion during the Coal Era, proved. Fawn T., 148
of the U F. C, replaced by a conglomerate of coal, slate, SS., &c, 268
of the Dar C., replaced by a similar mass of trash, ... 113, 114
of the Ferr L, replaced by Sandstone, 59, 93
Erosion of present surface, measured by isolated knobs, like Big Knob, Morg. SS, New Sew T, Beaver Co., 189, 190
Erosion of ancient river beds, refilled now and partially reexcavated or replaced by other valleys, with rock barriers in front, 4, 13, 14, 15, 16
Erosion of ancient, buried valleys, in N. W. Pennsylvania, Report of J. F. Carll, on the geology of the Oil Regions, ... 17
Erosion of Connoquenessing Valley, tortuous, why, . 104
Erratic blocks confined to west side of Beaver River; perched on the highest summits; destroyed by the farmers; thickly strewn near Beaver Falls; 10′ X 8′ X 6′ in Dar. T.—see Blocks, 10
Eurypterus—See Fossils, ... 56
Euomphalus—See Fossil Shells.
Exposures fine on Soap run, Measured Section, of 283½′, Franklin T. 219
also, on Clark's run, 546′, Big Beav T., 223
Fall of the Connoquenessing Cr. at the rate of 6′ per mile *above*, and 25′ per mile *below* the top of XII, 6
Fall of N. Fork of the L. Beaver R., Fredericktown, Ohio, 25′ per mile in sandstone, ... 6
Falls of the Beaver River in Potts Conglomerate No. XII, . . 5
of Trough Run, 20′ high, over Kitt SS., 200
of Bennett's run, over Cliffs of Pied SS., . . 206
in gorge of Pied SS., at Homewood Station, . . 225
of Little Beaver R over Pied SS., Ohio Line, 267
Farming land of the district, 7
Ferriferous Limestone described; eroded before the deposit of the Kitt. SS.—See Geological Indexes, . . 60; 93
Fertilizers, lime, &c., ... 7
Fire brick clay—See Clay.
Flux for iron furnaces, Ferr. L, at Vanport, ... 60, 61
Formations described in Chapter IV, . . . 22
Fossils in Crinoidal Limestone, Adams T., Bt. Co.; make up the whole mass in Franklin T., All. Co., . . . 77; 178
in Pine Creek Limestone; McCand T., All Co., . . . 168
in Buff. SS. (plants), Glade Cr., Forw. T., Bt. C., ... 108
in Brush Cr. L., numerous, Sew. T., All. Co., 177
in U. F. L. (bivalves, one univalve,) minute, . . . 85

Page
Fossils in Crinoidal Limestone—*Continued.*
over Darlington C in shales (plants), Ziegler's Mills, 113
under Darlington C in shales; Brush Cr, N Sew. T (coal and clay absent); in Ohio T, 56; 213, 234
in Ferrif L numerous, in shales between the benches, Pul T., on Trough run, in under-shales, Beav Riv., New Sew T ; at bend of Connoq. Cr. crowded; at Wilson's quarry, Frank T., numerous, in black shales under the L. at New Brighton; in shales under the limestone on the east Br. Brady's run, in L at Vanporte, 93; 194, 196, 200, 205, 210, 217, 250, 253, 254
under Clarion C., Trough run, Pul. T., indeterminable, 201
in Piedmont SS (tree stems), Pul. T, Beaver Co., 203
Fossil plants, List of species, determined —
Alethopteris sp? under L F. C, Soap run, Frank. T.
A. ambigua, Darlington Coal, 54
A. lonchitica, Dar. C., 54
A. nervosa, Dar. C, 54
A pluceneti, Dar. C, 54
A serlii, Dar. C., 54
A. sullivanti, Dar. C., 54
Annularia longifolia, Dar C, 54
A. sphenophylloides, Dar. C, 54
Antholites, two species, Dar. C., 55
Artisia transversa, Dar C., 55
Asterophyllites equisetiformis, Dar. C., 54
A. foliosus, Dar. C., 54
A sublævis, Dar C., 54
Calamaria, Dar C, 54
Calamites approximatus, Dar C., 54
C. nodosus, Dar C., 54
C. ramosus, Dar C, 54
C suckowii, Dar. C., 54
Calamostachys tuberculata, Dar C., 54
Callipteridium mansfieldi, Dar. C., 54
Cardiocarpus mamillatus, Dar C., 55
C. in roof of Mt Savage C., 68
Carpolithes cannelloni, Dar C., 55
C. clypeiformis, Dar C., 55
C. fraxiniformis Dar C, 5
C. multistriatus, Dar. C, 55
C. platimarginatus, Dar. C, 55
C. vesicularis, Dar C., 5
Caulopteris obtecta, Dar. C., 55
Cordaites borassifolius, under L F C, Soap run, Frank. T., 220
C. borassifolia, Dar. C., 55
C. mansfieldi, Dar. C., 55
C. principalis, Dar. C., 55
C. reflexa, Dar. C., 55
C in roof of Mt. Savage C., 68
Cordianthus, one species of male flowers, 55
two species of female flowers, Antholithes, 55

Page.

- Fossil plants—*Continued.*
  - *Cyclopteris elegans*, Dar. C., 54
    - *C. fimbriata*, Dar. C., 54
    - *C. obliqua*, Dar. C, 54
    - *C. trichomanoides*, Dar. C., 54
    - *C. undans*, Dar C, 54
  - *Dictyopteris obliqua*, Dar. C., 54
  - *Dicranophyllum species*, Dar. C, 55
  - *Equisitites infundibuliformis*, Dar. C., 54
  - *Fructus*, fruits, Dar. C., 55
  - *Filices*, ferns, Dar. C., 54
  - Fucoids, on the under surface of Kidney ore bed, roof of Brookville C., at New Brighton, 250
  - *Fungi*, mushrooms, the first found in any Coal Measures; Dar. C, 55
  - *Hymenophyllites expansus*, Dar C., 55
    - *H. gutbierianus*, Dar. C., 55
    - *H. lactuca*, Dar. C, 55
    - *H. laceratus*, Dar. C., 55
  - *Lepidophloios laricinus*, Dar. C, 55
  - *Lepidophyllum auriculatum*, Dar. C, 55
    - *L. foliaceum*, Dar. C., 55
    - *L. mansfieldi*, Dar. C., 55
    - *L. undulatum*, Dar. C., 55
  - *Lepidodendron* stems Dar. plant bed, 234
    - *L. modulatum*, Dar. C., 55
    - *L. quadratum*, Dar. C., 55
    - *L. obovatum*, Dar C., 55
    - *L. sternbergii*, Dar C., 55
  - *Lepidostrobus ornatus*, Dar. C., 55
    - *L. variabilis*, Dar C, 55
  - *Lycopodeaceæ* at the Darlington bed, 55
  - *Neuropteris angustifolia*, Dar. C, 54
    - *N. clarksoni*, Dar. C, 54
    - *N. cordifolia*, Dar. C., 54
    - *N crenulata*, Dar. C., 54
    - *N. flexuosa*, Dar. C., 54
    - *N. hirsuta*, Dar C., 54
    - *N. loschii*, Dar. C.; under L. F. C., Soap run, Frank T., Beav Co.. 54; 220
    - *N. plicata*, Dar. C., 54
    - *N. rarinervis* in shale under L. F. C., Franklin T, Beaver Co., 220
    - *N. tenuifolia*, Dar. C., 54
    - *N. vermicularis*, Dar. C., 54
  - *Odontopteris brardii*, Dar. C., 54
    - *O. neuropteroides*, in roof of Mt. Savage C., 68
    - *O. reichiana*, Dar. C, 54
    - *O. schlotheimii*, Dar. C., 54
  - *Pecopteris choerophylloides*, Dar. C., 55
    - *P. hemiteloides*, Dar. C., 54
    - *P. microphylla*, Dar. C., 54
    - *P. plumosa*, Dar. C., 55
    - *P. polymorpha*, Dar. C., 55

Page.
Fossil plants—*Continued.*
P truncata, Dar C., 55
P. sillimani, Dar. C., 55
P. squamosa, Dar. C, 55
Pinnularia capillacea in Dar. C., 55
Radices, roots, Dar. C., 55
Rhizomorpha sigillariæ, Dar. C., 55
Rhabdocarpus amygdalæformis, Dar. C., 55
R. bochsianus, Dar. C., 55
R. clavatus, Dar. C., 55
Rotophycus, fucoid on iron ore roof of Brookville C. Brighton, 250
Sigillaria alternans, Dar. C, 55
S. dentata, in Pottsville Congl. No. XII, 70
S elliptica, Dar C., 55
S mamillaris in Dar. C., 55
S monostigma Dar C., 55
S. reniformis Dar. C., 55
S sculpta Dar. C., 55
S. tessellata Dar. C, and also in Pottsville Congl., No. XII, 55, 70
Sphenophyllum emarginatum, Dar C., 54
S. longifolium Dar. C, 54
S. schlotheimii Dar. C., 54
Sphenopteris artemisifolia, Dar C., 55
S. mixta, Dar. C, 55
S newberryi, Dar. C, 55
Spiropteris villosa, Dar C., 55
Stemmatopteris mansfieldi, Dar. C., 55
Stigmaria ficoides, Dar. C., 55
Syringodendron cyclostigma, Dar C., 55
S pes-caprioli, Dar. C., 55
Trigonocarpus daviesii, Dar. C., 55
Ulodendron stems Dar. plant bed, 234
Fossil Polyps in the district·
Lophophyllum proliferum.
in Brush Creek L, (same as next?), 34
in L 180′ below Crinoidal L, 154
in Ferriferous L, 62
Fossil Bryozoan, small and very numerous, in L. 180′ below Crinoidal L (=? Brush Cr. L.), All. Co., Ind. T., 154
Synocladia biserialis, in Ferriferous L., 62
Fossil Echinodermata in the district
Crinoids in the Pine Creek L, in McCandless T., All. Co., 33, 168, 179
in Ferriferous L, abundant Whistler's run, Vanporte, &c., 60, 61, 193
Zeacrinus mucrospinus, in Ferrif L, 62
fragments abundant in the Mercer L., 68
Fossil Shells in the district
Astarte concentrica, in Crinoidal L, 30
Astartella concentrica, in Ferrif. L, 62
Athyris subtilita.
in Crinoidal Limestone, 30
in Pine Creek Limestone, 33

Page.

Fossil Shells—*Continued.*
in Brush Creek L., at Smith's Ferry, 264
in Ferriferous L., on Trough run, Pul. T., 62,200
in Mercer Limestone, 62
Aviculopecten carbonarius, in Ferr. L., 62
Aviculopecten whitei, makes up the mass of the "Aviculopecten bed" or black shale underlying the Ferriferous Limestone, Beaver River, North Sew. T. and Trough run, Pulas. T., 62,200,205
Aviculopinna americana, in Ferrif. L., 62
Bellerophon carbonarius
in Crinoidal Limestone, 30
in Ferriferous L., Trough run, Pulas. T., 62,200
B. montfortianus.
in Brush Creek Limestone, 34
in Ferriferous L., Trough run, Pulas. T., 62,200
B. percarinatus, in Ferrif. L., Trough run, 62,200
B. Stevensanus, in Ferrif. L., Trough run, 62,200
Chonetes mesoloba.
in Brush Creek L.; in Cran. T., But. Co., Ind. T., All. Co., and at Smith's ferry, Ohio T., Beaver Co., 34,74,154,264
in Ferriferous L., Whistler's run, Rock. T., All. Co., Trough run, Pul. T., at the Ohio Line, 62, 200; 267
C. C. and Productus, in Brush Cr. L., Econ. T., 179
Edmondsia aspenwalensis, in Brush Cr. L., 34
Euomphalus rugosus, in Ferrif. L., Trough run, 62,200
Hemipronites crassus, in Ferrif. L., Trough run, 62,200
Macrocheilus primigenius, in Ferr. L., 62
M. ventricosus, in Ferriferous Limestone, 62
Macrodon obsoletus, in Ferrif. L., 62
Nautilus occidentalis
in Pine Creek Limestone, 83
in Brush Cr. L., at Smith's Ferry, 34,264
in Ferrif. L., Trough run, Pul. T., 62,200
N ——? in Ferr. L., Trough run, 200
Nucula ventricosa, in Crinoidal Limestone, 30
in Ferrif. L., Trough run, Pul. T., 62,200
Nuculana bellistriata, Ferrif. L., Trough run, 62,200
Orthoceras cribrosum, Pine Cr. L., and also in Ferrif. L., both at Smith's Ferry, 83, 62,264
Platyceras tortum, in Ferrif. L., 62
Pleurotomaria carbonaria in Ferr. L. and under-shales, North Sew. T., 62,205
P. grayvilliensis, in Crinoidal L., 30
in Ferriferous Limestone, 62
P. turbinella, in Ferrif. L., 62
Polyphemopsis peracuta, Ferr. L., Trough run, 62,200
Productus costatus, Ferrif. L., Trough run, 200
P. longispinus, in Pine Cr. Limestone, 83, 62
in Brush Cr. L., Indiana T., All. Co., 68,154
in Ferr. L., Whistler's run, Rock. T., specially abundant on Beaver river, Pulas. T.; Trough run, Ohio Line, 193,196,200,267

Page
Fossil Shells—*Continued.*
in Mercer Limestone, 68
P. Nebrascensis, in Crinoidal Limestone, 30
in Pine Creek Limestone, 33
in Brush Cr. L. at Smith's Ferry, 264
in Ferif L. on Trough run, Pul. T., 62,200
in Mercer Limestone, 68
P. prattenanus, in Brush Cr. Limestone, 34
in Ferrif. L, Trough run, Pul. T, 62,200
P. semi-reticulatus, in Crinoidal L, 30
in Ferrif L., Trough run, Pul. T., 62,200
Solenomya radiata, in Ferrif. L, 62
Spirifer cameratus, in Crinoidal L., 30
in Brush Creek L., Ind T, All C., 34,154
in Ferrif. L., Whistler's run; Trough run, 62,193,200
S. lineatus, in Ferrif L., Whistler's run, 62,198
S. opimus, in Ferrif. L., 62
Spirorbis carbonarius, in Avic bed under Ferr. L, 205
Fossil Crustaceans in the district.
Eurypterus (Dolichopterus) mansfieldi, Darlington shales, (roof), 56,72
Bivalve in U F. L. on Little Beaver, 240
Eurypterus remipes? in Garland Conglomerate Venango Co., 72
Fructus—see Fossil Plants, 55
Freeport Group, described—see geological indexes, 43
Freeport Sandstone (Lower Freeport Sandstone), 50
Fucoids—see Fossil Plants, 250
Fungi—see Fossil Plants, 55
Gardening profitable, 8
Gallitzen bed of Cambria Co. (Brush Cr. Coal), 35
Garland Conglomerate of Venango County, 72
Gas from wells—see Wells
Geological Knowledge of some use in mining, 202
Geological Formations, Chap. IV.—see geological indexes, 22
Glacial drift—see Drift and Ice, 9
Glass-sand in Smith's Ferry oil-wells, 272
Glass pottery clay, Hampton T., 159
Gneiss cobble stones in drift, 9
Gorges—see Cliffs.—
made by the Sandrocks of the Barren Measures, 2
of the Connoquenessing Creek through Buff. SS and No XII., 5,16
of Little Bull Creek, Fawn T., All Co., 141
of Pine creek, in Hampton T., All. Co, 158
of Crows Run, Mahoning SS, New Sew. T., 187
of Trough Creek, Beaver Falls, Pul. T., 199
of Trough Creek, through U. F. Sandstone, 200
of Brady's Run, Mah. SS. and L. F. SS., 248
of Wolf Run, at Industry, through L. F. SS., 261
of Dry Run, through L. F. SS. 100′ thick, 267
of Bealer's Run, Ohio T., Beaver Co., 269
Granite in Drift—see Drift, 9,10,14,228
Gravel bed Terrace—see Drift and Terrace, 14,228

Page.
Greenstone (*trap*) in Drift, 9
Green Crinoidal Limestone—see Crinoidal L., 30
Hemipronites—see Fossil Shells.
Homewood axis—see Anticlinal, 22
Homewood Sandstone—see geological indexes.
Hymenophyllites—see Fossil Plants.
Ice floated boulders—see Drift, 10,237
Ice may have filled the valleys, 9
Industry Sandstone (Kittanning Sandstone), 59
Indian Sculptures at Smith's ferry, 265
Interconglomerate (Beaver River) Group, 65
Intervals—see geol. indexes. Vary quickly from 0′ to 40′, 39,148,258
Iron ore beds of the district in descending order—
  under Crinoidal L., balls plenty, Hampton T., All. Co., 160
  in Pine Creek L., E. Deer T. and Indiana T., 154
  in Brush Creek L., Davis run, Econ. T, Bea. Co., 34,183
  over U. Freeport Coal, local L ore, Hampton T., 159
  under U. Freeport Coal, blue paint, Smith's Ferry, 264
  in U. Freeport L.. Conn T., Shaler T., some layers are iron ore, Big Beav T., 47; 74, 125; 157, 224
  under U. Freeport L., Pine Cr., Hampton T., 161
  on L. F. L. Denny's; Swaney's run, Winfield T.; Winfield Furnace, Clearfield T, 49,94,93,96,138
  in L F. L nodules, always; on Crow's run pervaded with them, on Soap run, above Camp run, on Brush run, 49; 187, 219, 221; 241
  under L. F. L. at Anderson's bridge, Forward T. (see Johnstown Cement Bed), 111,112
  under the Darlington Coal, at Zelienople, in shales on Crow's Run, large and numerous nodules on Paved run, abundant on Trough run; very plenty at old Furnace, mouth of Deer Run; near Darlington, at Smith's Ferry, 117; 184; 194; 200; 222, 245; 263
  in the Kittanning Shales, 56
  on Ferriferous Limestone, "Buhrstone," on Rough run, Winfield T., But. Co.; Clearfield T., All. Co., 2′ ore in one plate, ½ mile below Vanporte (this turns to sandstone), 60, 92; 140; 256
  over Brookville Coal, nodules abundant at New Brighton, 250
  under Mt Savage Coal, Big Beav. T., 225
  in Pottsville Cong No. XII, impure, B. B. T., 225
  above and below Mercer Limestone, 69
Islands in the Ohio River are remnants of the lowest of the terraces, 11
Johnstown Cement Bed of Somerset Co.—See Iron ore, 11
Kidney Ore—See Iron Ore, above, 250
Kittanning Coal (L. Kitt. C.) Shales; Clay; ore; Industry S. S., 43; 56
  See geol. indexes, 57; 58; 59
Knob of Pittsburg C., 3 acres, Pine T., All. Co., 22
Knobs of Morgantown SS. in S. Butler and N. Beaver Co, 27
Knob of Crinoidal L. in Adams and Midd. T. T., Butler Co., 77; 80
Knob of Pitts. C (600′ + Ohio) carries Fifth Axis, 106
Knobs of Pitts. C., McCandless and Pine T. T., 168,170
Knobs of Pitts. C. in Franklin and Ohio T. T., 172,173,175
Knob of Morgantown SS, Killbuck Run, Ohio T, All. Co, 176

Page.

Knob of Elk Lick C. (Gross' Knob), Econ. T., Beav. Co., 180

Knobs of White L., reaching within 100′ of Pittsburg C., 180

Knob of Morgantown SS (Big Knob) 1450 + tide, 300′ higher than surrounding hills, New Sew. T, Beaver Co., 189, 190

Knobs of U. F. C. outliers, Frank T., Beav. Co., 218

Knobs of Mahoning SS., head of Soap Run, 218

Knobs covered with iceberg boulders, Dar. T., 237

Knob of Crinoidal L., head of Two-mile Run, 257

Knob of Buffalo SS. (?) at Industry, 260

Lacustrine Formation, 13

Ledges of Brush Cr. L. and Butler (U F) Limestones—See Cliffs, 226, 229

Lepidodendron, Lepidophloios, Lepidophyllum, Lepidostrobus—See Plants

Lime scarce in Barren Measures, good from Ferrif. Limestone, 6, 92

Limestone not recognized by the farmers, 8
- local under Brush Cr. C., in middle of Mah. S. S., 36, 37
- fragments, rolled cobble stones, in gravel drift, 9, 14
- brecciated (U. F. L)—See geological indexes, 47

Limestone Cement bed—See Johnstown, 56, 222

Limestone cut away to receive Kitt. SS. at Industry, 59

Little Pittsburg Coal wanting, 26

Local Coal bed under L. F. SS (Brady's Bend?), see Geol. Ind., 50

Lophophyllum—See Fossil Plants, 34, 154

Lower Pittsburg Limestone described, 26

Lower Red Shale of Barren Measures described, 31

Lower Productive Coal Measures, Chapter VI, 39

Lower Freeport C and L.—See geol. indexes, 48, 49
- called "Middle" Freeport in Somerset and Cambria Reports, 49

Lower Freeport SS. (Freeport SS of old reports), 50

Lower Kittanning Coal (Kittanning Coal), 57

Lower Homewood SS. (Connoquenessing SS. No. XII), 69

Lower Wurtemburg Limestone (Mercer L), 68

Lycopodeaceæ—See Fossil Plants, 55

Macrocheilus—See Fossil Shells, 62

Macrodon—See Fossil Shells, 62

Mahoning SS (upper member Buffalo SS.), 33
- Upper and Lower Mah. SS. in one section, 36, 37
- mistaken for the Butler SS. (L F. SS.) on Beaver River, 48

Massillon SS. (? No. XII) of Ohio, 69

Mercer Limestone (Lower Wurtemberg L.), 68

Metamorphic boulders—See Drift, 9

Mica scarce in Mahoning SS., Pul. T., 199

Mining a science, as well as an art, 208

Morgantown SS. described—see geol. indexes, 27

Mount Savage Coal, described—see geol. indexes, 68

Mushroom found in Coal Measures—see Foss. Plants.

Nautilus—see Fossil Shells.

Neuropteris—see Fossil Plants.

Nucula; Nuculana—see Fossil Shells.

Northern Drift—see Drift.

Odontopteris—see Fossil Plants.

Page.

Oil, Oil Wells, Oil and Gas, &c.—see Wells.
  oil from cannel shales at Darlington, ... 234
Old river beds crossing the present Valley of Beaver River—see Erosion, 15
Orthoceras—see Fossil Shells.
Outcrop of rocks always above 3d terrace—see terrace, . . . 18
Pebbles of quartz in Buff. SS. (nut size), . . 38,89,107,108
  in Mahoning SS., Crow's run, ... 186
  in Homewood (Piedmont) SS., Bennett's run, . . 205,206
  in Berea Grit, above Beaver Falls—see Conglomerate, ... 206
Pecopteris—see Fossil Plants.
Perched blocks—see Drift, ... 10
Philson (?) same as Brush Cr. L., described, . . . 34
Piedmont Sandstone (Upper Homewood) discussed, . 65
Pine Creek Limestone (? Coleman L.) 32
Pinnularia—see Fossil Plants.
Pittsburgh Coal bed, described; last outcrop to the North West, caps
    highest knobs—see geol. indexes, ... 21,22
Platt Coal of Somerset C. (?) described 31
Platyceras—see Fossil Shells.
Pleurotomaria—see Fossil Shells.
Polished stones in Terrace—see Drift 11
Polyphemopsis—see Fossil Shells.
Potholes and huge furrows, in Pied. SS —see Erosion, ... 250
Pottsville Conglomerate (No XII, Lower Homewood SS ?) . . . 5,65
"Practical" miners, dangerous guides in difficult cases. 202
Price Coal of Somerset Co. wanting? 31
Productus—see Fossil Shells.
Projected railroad crosses Pine Creek, McCand. T., All. C., ... 169
Pyrites in Coal—see Coal. 208
Quarries of Morgantown SS., Reserve T., All. C., ... 164
  of Mahoning SS., Sew. T, All. Co.; on Legionville run, Econ. T.; Crow's run, Econ T (large); on hill over Crow's run, New Sew. T., above Forks of Crow's run; on Brush Cr., New Sew. T., Lutz's, at Unionville, New Sew. T.; N. Br. Block House run, Pul. T., described; in Chip. T., . 177; 182; 184; 185; 186; 188; 198; 246
  of Butler (U. F.) Limestone, Crow's run, N. S. T., . . 187
  of Butler (U. F.) Sandstone, at Muntz's, Butler T.; Summit T., 130,185
  of Freeport (L. F.) Sandstone, Smith's extensive on Beaver run, Pul. T.; at Darlington, ... 105,230
  of Ferriferous Limestone at Vanport, ... 255
  of Piedmont Sandstone, Hazen's bridge, North Sew. T., Beav. Co., . 209
Quartz pebbles in Buff. & Mah. SSS., ... 37,127
Quartzite cobble stones in Drift—see Drift, ... 9
Radices, roots—see Fossil Plants
Redshales of the Barren Measures—see geol. indexes, ... 7,31
Rhizomorpha—see Fossil Plants.
Rhabdocarpus—see Fossil Plants.
Rock-barriers in Alluvion—see Erosion 16
Rotophycus—see Fossil Plants.
Rolls in Brush Cr. Coal, Cranberry T., But. Co.—see Coal, . . 74
River Channels now filled—see Erosion, . 14

Page.
Rivers and streams of the district enumerated, . . 3
Sandstone massive (beneath Kitt C.); at Grey's Mill, W Deer T., All Co , turns (Mah. SS.) to shales on Crow's run; (under U. F C.) on Trough run; ancient sea beach (Pied SS) at Homewood, cuts out buhrstone ore over Ferr. L., below Vanporte; Brighton Co.—see geol indexes, . 139, 151, 187, 200, 225, 256
Salt and salt wells—see Wells.
Saxon gas well—see Wells.
Scenery of Connoquenessing Cr and Beaver River wild and fine, 6,225
Schantz's Coal (L. F. C.) Connoq Cr., 49
Section of terraces, ... 12
Sections of the whole Column of rocks, ... 23
Section of Upper and Lower Mahoning SS , . . 37
Sections at Kittanning, New Brighton, and Smith's Ferry, 40, 41
Section of Beaver River Group, . 64, 66
For others, see List, or Index of Sections.
Shales, red, variegated, Barren Measure, ... 26, 28, 29
Sharon Coal Group and Coal Bed described, ... 66, 70
Sigillaria—See Fossil Plants.
Soils of the district described, . ; 6
Strip Vein of Ohio (Darl. C , U. K C,), . . . 58
Solenomya—See Fossil Plants
Sphenophyllum, *Sphenopteris*—See Fossil Plants.
Spirifer—See Fossil Shells
Spiropteris—See Fossil Plants.
Spirorbis—See Fossil Shells.
Stemmatopteris—See Fossil Plants.
Stigmaria—See Fossil Plants
Stillwater Sandstone (Buffalo SS), ... 34
Sulphur binders in coal—See Coal, ... 95,119
Sulphur Vein (Kitt. C.) Smith's Ferry, ... 265,266
Sculptured rocks at Smith's Ferry, ... 265
Summit Vein (U. F. C), Winfield T., But Co., 93, 94
Summit Ore, on Butler L , ... 96
Synclinal on Bull Cr., Fawn T , All. Co , 145
Synclinal west of Fifth Axis, in McCand. T. All. Co., . . . 167
Synocladia—See Fossils
Syringodendron—See Fossil Plants.
Terraces—See Drift.
Terra Cotta Works—See Clay, ... 12, 59
Tionesta Sandstone, ... 67
Theory of Erosion—See Erosion, 17
Thinning of the Lower Productive Coal Series westward slight, . 39
Topography of the district discussed, Water-sheds described; shape of the hills; valleys smooth below and rough above; wilderness of the Connoquenessing; Topography illustrated by Thorn Cr., Penn T., But. Co., . . . 1, 2; 8; 22, 100
Towns built on the 2d terrace, Sewickley, Phillipsburg, N. Brighton, Beaver Falls, Rochester, ... 11
Towns built of the 3d terrace, Economy, Beaver, Georgetown, Upper Rochester, N. Brighton, Beaver Falls, ... 11

Page.
"Town rocks," Masses of Buff. SS.—See Blocks, 104
Trigonocarpus—See Fossil Plants, 55
Tutenmergel in Ferrif. L.—See Cone-in-cone, 200
Ulodendron—See Fossil Plants.
Upper Freeport Coal (E.), Under-clay, White Limestone (of Ohio survey) never fossiliferous, perhaps fresh water—See geological indexes, 43; 46; 47
Upper Homewood Sandstone described, 67
Upper Kittanning Coal described (Darlington C.), 51
Upper Pittsburg Limestone described, 26
Upper Red Shale of Barren Measures described, 26
Valleys in Lower Coal Measures smooth; rough above, 2
Variations in Ferrif. L., Darlington roof, and other measures, 60,210,212
Vanporte Limestone (Ferriferous L.), geol. index, 60
Water-lime group of New York Geology, 72
Water sheds described, 2
Wells bored through Alluvion, 15
Wells bored through the 1st, 2d, and 3d terraces, 13
  Salt wells, Jackson T., Butler Co., 115
    On Yellow Cr., Lancaster T., But. Co., 118
    At Salt Works of Robertson Run, E. Deer T., 147
    Got brine 365′ to 385 below U. F. C., 147
    At Tarentum, brine 400′ below U. F. C., 147
    In Brighton T., Beav. Co., 850′ below Brookville C., 253
    At Industry, brine, gas oil, 800′ deep, 260
    At Industry, brine 322′ below Kitt. C., 260
  Gas Wells, at Lardintown, Clinton T., But. Co., 83
    Chantler well No. 1, heavy gas vein, 87
    Saxon gas well, in Winfield T., But. Co., 96
    At Rochester and Freedom, gas used in Works, 191
    Economy Company's gas well above Beaver Falls; used in Cutlery Works, 205,206
    Economites' well at New Brighton, 248
    In Brighton T. yield gas and salt water, 253
    At Industry (800′) yield gas, oil, and brine, 260
Oil wells, in Clinton T., Butler Co., 81; 87
    On Rough run, in Winfield T., But. Co., 1st Sand 900′; 3d Sand 1,400′, 95
    On Thorn Creek, Jeff. T., But. Co., 98
    At Frazier's Mill, deep well, 99
    Above Buhl's Mill, Connoq. Cr., Forward T., 108
    At Butler; at Carbon Centre, Sum. T., 182; 184
    Herman's well, Summit T., But. Co., 136
    Hume's well, Clearfield T., But. Co., 137
    At Tarentum, oil at 400′ below U. F. C., 147
    At Franklin's Old Mill, Indiana T., 155
    On Crow's run, boring, New Sew. T., 187
    Rochester Tumbler Co.'s Oil sand, 915′, 191
    At Rochester, oil sand 1,170′ below U. F. C., 191
    Economites' boring above Beaver Falls, 205
    At Darlington; Mansfield's well, 231,232
    Lancaster and Beaver Co.'s wells, Brighton T., 253,254

Oil Wells—*Continued.* Page
Industry well, oil and gas, 742′ below Kitt. C., ... 260
At Smith's Ferry, 1st Sand, Piedmont SS., 2d Sand 700′ to 730′ below Kitt. C., . . 270
Butler County Oil Sands wanting in the Smith's Ferry Wells, 272
Wilderness country of the Connoquenessing, . 5
Zeacrinus—see Fossil Shells, . . . 62

B.---GEOLOGICAL INDEX TO Q.

Arranged in Order of Super-Position.

a SOUTHERN HALF OF BUTLER COUNTY.

- Barren Measures in Cranberry and Adams TT. have no massive sandstones, . . . 75
- Barren Measure Coal beds very irregular, 77
- Morgantown Sandstone blocks over Hayes' Mill hill, Middlesex T., 79, 80
- Elk Lick Coal (30' + Crin. L.), Middlesex T., Buffalo T., . 79; 91
- Crinoidal Limestone = Green Crinoidal L. of Geol. of Pa., 1858
  - in Adams T, in Stoup's high knob, . . 77, 78
  - in Buffalo T the highest rock (80' + Bakerstown C.) covers Hayes Mill Knob with blocks full of fossils, on all the highest knobs of Southern Buffalo T, . . . 79, 80; 91
  - in Jefferson T, with Red Clay band underneath, . 99
  - in Penn T., Butler Plank Road, high knob, . . 101
  - in Connoquenessing T. ought to be in the ridge, between the Big and Little Connoq creeks, . 127
- Red Shales under the Crinoidal Limestone, (Lower Barren Measure Red Shales.
  - in Adams T. makes a sterile belt around the knobs, 77
  - in Buffalo T. (450' + U. F. C.), at Monroeville, . 89
  - in Penn T., over Thorn Creek, . . . 102
- Bakerstown Coal (=? Coleman C., of Somerset Co)
  - in Adams T., 100' over Break-neck Cr., Park's mines, 76, 77
  - in Middlesex T., on S. Br. Glade Cr., double bed; cannel, . 79, 80
  - in Winfield T. (175' above U. F. C.), . . 96
  - in Jefferson T. (175' + U. F C.), on Thorn. Cr., black shale, . 99
  - in Penn. T., mouth of Thorn Creek, ... 103
  - Schaffner's *coal over Buffalo SS.;* and Renfrew's Coal, variable, 128
- Pine Creek Limestone, in Winfield T., on Rough run, ... 96
- Buffalo Sandstone = Upper Mahoning Sandstone.
  - in Adams and Cranberry T. T., not massive, ... 75
  - in Adams T., in bed of Break-neck Creek, ... 78
  - in Buffalo T. reaches its greatest development (70' to 80'), ... 87
  - in Winfield T. (80') massive conglomerate, on Little Buffalo Cr., . . . 96
  - in Penn T, massive under Bakertown Coal, . . 102
  - in Forward T. (50' solid) in one cliff; cause of the tortuous course of the Connoquenessing Creek, one mass of pebbles; coarse, yellow-white rock, with many casts and prints of wood; cliffs below mouth of Glade Creek, ... 104, 106; 107; 108
  - in Jackson T., thins away, and changes the topography accordingly, 112
  - in Connoq. T. not so conglomeratic, ... 124
  - in Butler T., a mass of quartz pebbles, Renfrew's Mills, . 127
  - in Summit T., quite massive and conglomeratic, . . . 135
- Brush Creek Limestone (=? Philson L., Somerset Co.), in Cranberry T., type locality; holds *Chonetes mesoloba* in great numbers, . . 74

Page.

- Brush Creek Coal (=? Gallitzin C., of Somerset Co.)
  - wrongly called "Elk Lick" Coal in Report K., 74
  - in Cranberry T. type locality, clay veins and rolls; but the sole dependence of the people of the township, 74; 75
  - in Adams T. (70' + U. F. C.), on Breakneck Creek, 76
  - in Forward T. (6'' thick) between Buffalo and Mahoning SSs., 105,107
  - in Lancaster T. (3' to 4') (50' + U. F. C.) Kiefer's, 122
  - in Connoq. T., mined extensively and preferred, variable and often absent, . 123, 126
- Mahoning Sandstone, or Lower Mahoning Sandstone
  - in Cranberry T. forms the roof of U. F. Coal bed, . . 73
  - in Clinton T. cuts out the U. F. Coal bed, . . . 86
  - in Buffalo T. cuts out the U. F. Coal bed at Monroe Station, . 89
  - has its greatest Butler Co. development in huge cliffs along Little Buffalo Creek, 87, 90
  - in Forward T. holds two *coal beds* in its body, . . . 106,107
  - yields good building stone at Evansburg, 108
  - in Butler T. not at all massive, at Muntz's, but very massive (40') in a shaft close by, ... 129
- Lower Productive Coal Series thins slightly, going north-west, 39
- Upper Freeport Coal bed (E.) described, 43
  - in Cranberry T. variable on Brush Creek, Mah. SS. roof, ... 73
  - in Adams T. Cannel roof, on Breakneck Cr.; on Glade Cr., .75; 78
  - in Middlesex T. on Bull Creek, . 80
  - in Winfield T. called "Summit Vein," 94
  - in Forward T. Cannel roof (4''), on Glade Creek, . 108
  - in Connoq. T. a mere streak, at mouth of Semiconon Cr., 126
  - Shantz's Coal on the Connoquenessing, . 49
- Upper Freeport, under clay, described, 46
- Upper Freeport Limestone, (Freeport Limestone,) also (White Limestone of Ohio) described, never fossiliferous; fresh water? 47
  - in Cranberry T. compact and containing much iron, 73,74
  - in Adams T. on Breakneck Cr., very ferrug. on Glade Creek, 75,78
  - in Clinton T. two layers, the lower one an iron ore, . . 83
  - in Penn T. brecciated and ferruginous, . 100
  - in Forward T. poor and ferruginous, Brown's Mills, . 108
  - in Jackson T. brecciated, at Zeigler's, 116
  - in Connoq. T. contains nodules of iron ore, ... 125
  - in Butler T. varies from 3' Solid L. to nodular iron shales, . . 131,132
  - in Summit T. quarried, ferruginous, slakes badly, . . 134,135
- Upper Freeport Sandstone (Butler Sandstone).
  - in Winfield T. coarse. reddish brown, micaceous, . 94
  - in Butler T. type locality—see description, . 130
  - in Summit T. quarried; tolerably massive, . . 135
- Lower Freeport Coal (D).
  - in Penn T. unreliable—see Kennedy's banks, ... 103
  - in Jackson T. double bed, semi-cannel layer, 113,114,115
  - in Summit T. has a *limestone* under it, . 133
- Iron Ore (Summit Ore) over the Butler Limestone everywhere, . . . 94,96

Page.

Lower Freeport Limestone (Butler Limestone)=described , Mid. F. L. of H, IIH, HHH Not recognized by old Survey, because wanting at Freeport, 49
  in Winfield T. "bastard," brecciated, ferruginous, 94
  in Forward T. Anderson's Mill, brecciated, dark, . 111
  at Zelienople mistaken (by First Survey of Pa.) for the (Upper) Freeport Limestone, . 117
  in Connoq. T contains nodules of iron ore, 124
  in Butler T somewhat brecciated, 130
  in Summit T Newman's branch, (3') Sunset Station, 133;135
  in Clearfield T "Bastard Limestone," local name, earthy and impure, with iron ore upon it, . 138
Lower Freeport Sandstone (=Freeport Sandstone) described, 50
  in Forward T. bluffs (75') at Evan's mill, 109
  in Jackson T. thickens, 116
Upper Kittanning Coal (Darlington Coal) C' (Strip Vein of Ohio), 51,53
  in Buffalo T on Buffalo Creek, below the Forks (2') pure, . 90
  in Forward T. bed of Connoq. Cr , below Buhl's Mill, 109
  in Jackson T split up, at mouth of Breakneck Creek, and receives a new bench in its roof, 113
  in Lancaster T. neglected by the people above Yellow Creek, 120
Eichenhauer's Coal (? Darlington C ? Kittanning C)
  in Lancaster T. 1 mile East of Yellow Creek (8' 1") local, . 121
  in Lancaster T. mouth of Crab run (8' 8") local, 122
  in Butler T. Muntz's Section No 16 (1' 2") local, . 130
Kearn's (probably Darlington) coal, Summit T. (2' 8½"), 132,133
Lower Kittanning Coal (Kittanning Coal) C. described, 57
  in Jackson T. in Salt well (4') 45' below Darlington C., . 116
  in Lancaster T. on Yellow Creek, with sulphur binders, . 119
  in Clearfield T a very large bed, split into three, on west branch of Big Buffalo Creek (8' and 10' 9" thick), 138,138
Lower Kittanning Sandstone (=Kittanning Sandstone).
  in Winfield T. in the bed of Rough run bed, . 95
  in Clearfield T. (20') massive, . 139
Ferriferous Limestone (Lower Kittanning Limestone) ; great variations, 60
  in Winfield T. (18'), making an unbroken cliff on Rough run, . 92
  in Lancaster T. cut away by Sandstone, on Yellow Creek, 119
  in Clearfield T. (15') makes cliffs on Buffalo Creek, . . 139
Clarion Coal, in Winfield T., ... 92
Piedmont Sandstone in Winfield T., ... 91,93,95
  in Jefferson T. struck in Oil well, ... 99
Corn-meal Sand; Stray Sand, Boulder Sand; and Red rocks, 100' thick in Oil well, . . 81,82

b. NORTH-WESTERN PART OF ALLEGHANY COUNTY.

Pittsburg Sandstone (Upper Pittsburg SS.) caps the highest Knobs, 22
  in Indiana T., blocks of it cover the Knob, ... 158
  in Ross T., in Knob, on 5" Axis, 600' above Ohio River, ... 166
  in McCandless T., blocks left on Pine Cr. Knob, . 169
  in Franklin T., blocks scattered about, ... 174

Page

- Pittsburg Coal Bed, described, type sections, 21
  - in W. Deer T., in high Knob, 150
  - in Indiana T., in high Knobs, Campbell's Knob, 152,154,155
  - in Shaler T., in Irwin's Knob, 158
  - in Reserve T., summits of the northern part, 164
  - in Ross T., in high Knobs, 166
  - in McCandless T., in Knobs (1,325′ + tide), head of Pine Cr., 167,168,169
  - in Pine T., N. W. outlier, highest land (1,360′ above tide, 22, 170, 171
  - in Franklin T., in three Knobs, 172,173
  - in Ohio T. near Franklin T. line, 175
- Upper Little Pittsburg Limestone described, 26
  - in Indiana T., 30′ below Pittsburg Coal, 154
- Upper Variegated Shales, described, 26
- Lower Little Pittsburg Limestone described, 26
  - in Ross T., 80′ to 90′ below Pitts. C., at Perryville, 167
  - in Pine T., 90′—P. C., No. 4 of Emmit's Pine Cr. section, 171
- Upper Barren Measure Red Shales described, 7, 26
  - in Pine T., below Little Pittsburg Limestone, 171
  - in Ohio T., 90′ below Pittsburg Coal; Lowrie's run, 175
- Morgantown Sandstone, described, 27
  - in Reserve T., quarried, massive, 164
  - in Franklin T., quite massive on Pine Creek, 174
  - in Ohio T., Cliffs on Killbuck run, 176
- Lower Variegated Shales described, 28, 29
- Elk Lick Coal
  - in E. Deer T. (360′ + U. F. C.), head of Hite's run, 149
  - in Indiana T., slaty, 154
  - in Reserve T., cannel, on Wood's run, 164,165
  - in Pine T. (250′ below Pittsburg C.), 171
  - in Franklin T., on Duff's run, Pine Creek, 172,174
- Elk Lick Limestone
  - in Reserve T. (35′ + Crinoid L.), on Wood's run, 164
  - in McCandless T., on Pine Creek, 168
- Crinoidal Limestone.
  - in W. Deer T., 151
  - in Indiana T. (300′—Pitts. C.), split by shales, Big Deer, 153,154,155
  - in Shaler T., hill top; 110′ above Alleg. Riv., Girties run, 156,157
  - in Hampton T., earthy, full of fossils, 160
  - in Richland T., Bakerstown, Wood's run, 163
  - in Ross. T., outcrops along Girtie's run, 167
  - in McCandless T., 80′ above bed of Pine Cr., 168,169
  - in Pine T., on Pine Creek, 171
  - in Marshall T., 172
  - in Franklin T., a mass of fossils, 173
  - in Ohio T., on Lownes' run, 175
- Berlin Group of coal beds of Somerset County, 147
- Platt Coal of Somerset Co. (?), under the Crinoidal L., described, 31
  - in Shaler T. (10′ below Crin. L.) and (100′ above Pine Cr. L.), local coal on Girtie's run, 158
  - in McCandless T., (1½) under Crin. L., at Moon's, 168

Page
Middle Barren Measure Red Shales
  in McCandless T., under Crin. L., Pierce's hill, Pine Creek, 169
  in Marshall T, under Crinoidal Limestone, . 172
Price Coal bed? Wanting, . . 31
Bakerstown Coal
  in Richland T (90 below Crin L) type locality, . 162
  in McCandless T. (30' above Pine Cr L.) and lying on a massive Sandstone, Cannel, Moon's mines, Pierce's branch of Pine Creek, . . 168,169
  in Pine T. (75' below Crin L), Pine Creek, . . 171
Bakerstown Sandstone
  in Shaler T. (40' above Pine Cr. L), Girtie's run, 158
  in Reserve T., 100' thick along the Ohio river, 165
  in Ross T, massive cliffs along Girtie's run, 167
  in McCandless T., massive, 168
Lower Barren Measure Red Shales, described, . . 31
  in Indiana T, over the Brush Creek Coal and Limestone, . 155
Pine Creek Coal
  in West Deer T, Culmersville P. O, . . 151
Pine Creek Limestone, described, . 32
  in Deer T., an impure iron ore, on Hite's run, 149
  in Indiana T hard, silicious, holds iron ore, Dorseyville, 154,155
  in Shaler T., mouth of Wible's run, 157
  in Hampton T. type locality, Pine Creek, Herron's on top of Buffalo SS.; fossiliferous, 15' above mouth of Montour's run, 160,161
  in McClure T, Ohio river, Wood's run, ferruginous and fossiliferous, cut out by the closing together of SS above and below it, 165
  in McCandless T lowest rock exposed, Montour's run, 167,168
  in Marshall T., . 172
  in Ohio T. brecciated, fossilliferous; Killbuck run, 176
Buffalo Sandstone described, holds quartz pebbles, 33, 89, 107,108
  in Fawn T huge cliffs on Little Bull Creek, . 141
  in Indiana T massive over Brush Cr Limestone, 155
  in Shaler T cliffs along Little Pine Creek, . 158
  in Hampton T. (95' thick) immediately below Pine Cr. L., cliffs, 160,161
  in Reserve T. massive outcrop from Wood's run to Haysville, . 165
  in Ohio T. cliffs along the Ohio river, Springhouse run, up Killbuck run; up Lowrie's run, (not a conglomerate;) but no cliffs seen west of Ohio township, . . . 175,176
  in Sewickley T mere mass of shales along Sewickley Creek, . 178
Brush Creek Limestone described, . . . 34
  in Indiana T. (180'—Crinoid. L.) many fossils; Big Deer Cr., 154,155
  in Shaler T. exposed at mouth of Pine Creek, . 156
  in Hampton T. described, (40' + Water,) Pine Cr., mouth of Crouse's run; fossiliferous, . . 161
  in Richland T. described; West Branch Deer Creek, . 162
  in Ross T. on Jack's run, . . . 167
  in Marshall T on Sewickley Creek, . . . 172
  in Ohio T, at R R. track, Springhouse run; sandy, fossiliferous, Killbuck run, ... 175,176
  in Sewickley T., fossiliferous, ... 177,178

Page

- Brush Creek Sandstone.
  - in Indiana T. 12' below Brush Creek Limestone, 155
- Brush Creek Coal.
  - in Fawn T. (60' above U. F C) described, Lit Bull Cr , 142,145,146
  - in Indiana T (?) 180' below Crinoidal Limestone, 154,155
  - in Sewickley T , 177
- Mahoning Sandstone described, 36,37
  - in Fawn T. massive, 143
  - in Shaler T. cliffs along Pine Creek, 156
  - in Ohio T. top of it visible at mouth of Springhouse run, 175
  - in Sewickley T. quarried on Little Sewickley Creek, mouth of Sewickley, 177,178
- Gourd Head Run Clay (local)
  - in Hampton T. Fire brick clay on Pine Creek, 159,161
- Gourd Head Run Limestone (local).
  - in Hampton T. thins away and grows earthy in Pine Cr. Section, 159,161
- Upper Freeport Coal (E.)
  - in Fawn T anomalous deposit; split up on Bull Creek, 143,144,145,146
  - in E. Deer T. very large, doubled, split up, cannel top, 148,149
  - in Shaler T exposed by 5'' Axis on Pine Creek, double, Miller's mines, no top bench, on Pine Cr runs out entirely, 180' above Allegheny R. at mouth of Girtie's run, 156,157
  - in Hampton T. a thin streak of Coal *between two limestones* on Gourd Head Run, represented on Pine Cr by a few streaks, 159,161
  - in Richland T. nowhere nearer surface than 100', 162
  - in Marshall T. 100' beneath Brush Cr. water, entering Butler Co., 172
  - in Ohio T. 75' *beneath* Ohio R. bed, at *east* T. line, and 35' to 40 at *west* T. line, 174
- Upper Freeport Limestone
  - in Fawn T. divided by shales into three benches, 142
  - in Shaler T hard and ferruginous, 157
- Upper Freeport Sandstone (Butler Sandstone).
  - in Fawn T. (?) at Dawson's mills, 146
  - in E. Deer T massive conglomerate layers, 147
- Lower Freeport Coal.
  - in Hampton T. thin (perhaps wrongly identified), 159
  - in Pittsburgh, 250' (estimated) beneath Ohio River, 165
  - at Wood's run mouth, 80' to 100' beneath the Ohio, 165
- Lower Freeport Limestone (Butler Limestone).
  - in E. Deer T. cut away by the descent of U F. (Butler) SS , 148
- Ferriferous Limestone.
  - in E. Deer T. 272' beneath U. F C., mouth of Robertson's run, 148

c. NORTHERN PART OF BEAVER COUNTY.

- Barren Measures.
  - in Industry T., Section shown for 270' above U. F. C., 261
- Lower Pittsburg Limestone.
  - in Econ T , white L. 100'—Pitts. C and 200' + Crin. L., 180
- Morgantown Sandstone.
  - in New Sew T. makes cliffs around Big Knob, 190

Page.

Elk Lick Coal
- in Econ T., 40' + Crin L., on Gross' Knob, . 180

Crinoidal Limestone
- in Econ. T., in knobs near Wall Rose P. O., 180' + McPherson's Creek, on Davis' run, 180, 183
- in New Sew T., 195' + Brush Cr. C., head of Crow's run, 100' below summit of Big Knob, 187-190
- in Brighton T., probably present on knob at head of Two-mile run, 50' + red clay, 257

Upper Barren Measure Red Shales.
- in Econ. T., makes a conspicuous show, . 180
- in S Beav. T., high lands at head of L. Brush run, 242
- in Brighton T. (?), hill top, 300' + U F. C., Two-mile run, 257

Pine Creek Limestone
- in Econ. T., mouth of Fink's run, over Crow's run; nodular iron; fossiliferous, . 179, 180
- in Ohio T., Smith's Ferry, (2' thick), fossils, 263, 264

Buffalo Sandstone.
- in Econ T., Crow's run, massive, cliffs, 180
- in Franklin T., massive, cliffs, conglomeritic (no 4' coal under it), 219, 220
- in Industry T. (?), on hill top, over Industry, . 260
- in Ohio T., Smith's Ferry, massive plate, graduating downward into shales, . 264

Variegated Shales.
- in Chip T., at head of Brady's run, . 245, 246

Brush Creek Limestone.
- in Econ T (?), holds *Chonetes*, *Productus*, &c., a black, calc. shale, full of fossils, (20' + Brush Cr C., usually only 10',) 179; 181; 183
- in New Sew T., seen in blocks, head of Crow's run, 187
- in North Sew. T. (?), over Homewood Station, 10' + Brush Creek Coal, looks like clay, 208
- in Big Beaver T. (5' +), described, makes cliff at R. R. summit, shelvy, slaty, 224, 226
- in Chip. T. (?), 70' above U. F. C., makes good lime, no coal with it, on Thomas' branch of Brady's run, 244, 245
- in Ohio T., (1') at Smith's Ferry, fossiliferous, 263, 264

Brush Creek Coal.
- in Econ T., variable at Rock's mine; roof cannel, 181
- in New Sew. T., variable, head of Crow's run, . 187, 188
- in North Sew. T., crops on New Castle road, Homewood Station; cannel, head of one branch of Brush Cr., . 208, 213
- in Darl. T., called "*Three-Foot Bed*," 65' + U. F C., 3' thick, very fine coal, head of Dilworth's run, black, pitchy, head of Coal run, like "block coal;" (3' thick) 1 m. S of Enon Stat., fine smith coal, ... 235, 236, 237
- in S Beav. T., smut about 3' thick, seen, . 240
- in Chip. T. (85' + U. F. C.), over Brady's run, absent on Thomas' Branch of Brady's run, 244, 245
- in Indus. T., smut seen on knob over Industry, . . . 260
- in Ohio T., smut seen at Smith's Ferry, and on Bealer's run hills, 264; 269

Page

Coal, possibly the Brush Creek Coal.
- in New Sew. T (50' + U. F. C.), once mined above Unionville, 189
- in Ohio T. (35'? ± + U F. C), called "Three-Foot Vein," 232

Mahoning Sandstone, not on the Beaver River, 48
- in Econ T., quarried on Legionville run, extensively on Crow's run, massive, coarse, conglomerate, on Davis' run a mere mass of shales, holds pebbles of quarts, 182, 183, 184, 186
- in New Sew. T, much quarried over Crow's run, huge at Forks, wall of cliffs, sinks and reappears as mere shale at head of Crow's run, quarried, massive, on Brush Creek, Goehring's, Lutz's, Unionville, Big Knob, outlier, 15 m. from any other outcrop, . 185, 186, 187, 188, 190
- in Pul T., huge blocks over Block-house run, mica scarce in it, cliffs over Beaver Falls, . 197, 198, 202
- in North Sew. T. massive over Homewood Station; cliffs resting on U. F. C on Brush Creek, massive cliffs on Broad run, 208, 212, 214
- in Frank T. knobs; huge blocks, pebbly, head of Soap run, 218
- in Big Beaver T. cliffs along Jordan's run, 227
- in Darl. T massive, rests on U. F. C and often cuts it out, . 230
- in S Beaver T. cliffs and blocks along L. Beaver Cr., 289, 240
- in Chip T. quarried in hill top over Beav. Falls R R Stat, 246
- in Patt. T. massive over New Brighton, 248
- in Brighton T. massive, huge blocks, on hills, up Two mile run, immense cliffs and blocks, 6 Mile Run, S of New Lisbon, 40' above U F C. at one place, on U F C close by, 256, 257, 258
- in Industry T cliffs, 260
- in Ohio T. (80' thick) at Smith's Ferry, coarse conglomerate, cliffs, unusually coarse conglom on the Ohio State Line, 264, 267

Coal Bed *local* (? U. F. C.=E).
- in Franklin T. (4' thick) under a massive Cong. SS, but seems to disappear on Soap Creek waters, ·219, 220

Upper Freeport Coal (E)
- in Econ. T keeps about 30' above bed of Sewickley Creek, near level of Crow's run; 50' above the Ohio at Economy, at grade Baden St, turns to a streak of shale on Davis' run, 179, 180, 181, 182, 183
- in New Sew. T. exposed all along Brush Creek, *thin* on Crow's run; not workable *down* Brush Cr.; mined at Unionville (Brush Creek) and two miles below; but very variable; only locally workable, *runs out southward to nothing*, 185, 186, 188, 189
- in Pulaski T (0'' to 8'' on Blockhouse run, (2') head of east branch; (1¼') roof, Mah SS north fork, finely seen in hill top over Beaver Falls, under cliffs of Mah. SS, 197, 198, 199, 202
- in North Sew. T. (4') opp. Homewood Stat. 450' + Beaver river level, (2½') roof, Mah. SS.; thin on Brush Creek, Broad run, (3') 90' beneath Brush Creek Coal, 207; 212, 213, 214
- in Marion T. nowhere workable, 214
- in Franklin T. (4') outliers on hills of Soap run, 218
- in Big Beav. T. absent from R R. Summit section, (3' to 6' thick) Marshall's mines; a few inches thick, under Mah. SS. Jordan's run, (4') Wallace's run, 224, 226, 227; 229

Page.

Upper Freeport Coal—*Continued.*
in Darl. T (2½) cut away to 0 by Mah. SS roof, mined largely (3½′, 4½′) on Coal run, (4′) in central area of T, roof (=2′ black slate) and sometimes Coal also cut away by descent of Mah. S. S along Ohio State Line, thinned to a few inches (50′ — Brush Cr O) at Enon Valley, 230, 232, 234, 236, 237
in South Beaver T. (4½′) top and bottom slaty, woolen mill, L Beaver Cr, (4′) 200′ + Brush run water, lower branch slaty; 50′ + L F C on Little Brush Run, 239, 240, 241, 242
in Chip. T. 180′ above Kitt C. on Brady's run; (27″ to 17″), (4′ 8″, 4′ 7″) bottom slaty, above Darlington, (2′ to 7′ variable, main bench a fair coal, 244
in Patt T seen in hill tops over New Brighton, 248
in Brighton T. unworkable up Two-mile run, just under Mah. S. S., (2½′ impure) on Six-mile run, (5′ in six benches) cannel ½ m. below Forks, 6 m run, 256; 257, 258
in Industry T (3½′ impure) Six-mile run, (4′) at Industry, (3′ good) Wolfrun east branch; (2½′ slaty) west branch; 280′ above the Ohio at Industry, mines above Industry abandoned, 259, 261; 262
in Ohio T. bad all around Smith's Ferry, (2′) abandoned on Dry run; (4′ good) top semi-cannel, Island run; cut away by the descent of a trash gravel deposit, on Island run; thins to 0 on Ohio State Line, . . 264, 267, 268; 269

Upper Freeport Fireclay
in Econ T very pure on Davis's run, 183
in Big Beaver T manufactured into fire brick at Summit R. R., 224

Upper Freeport Limestone
in Econom T., described on Tirebaugh and Davis' runs, 183
in New Sew. T., on Crow's run, wrinkled aspect; on Brush Cr, 186, 188
in Pulaski T., on Block-house run forks, top good, bottom ferruginous, all fossiliferous, in Beaver Falls Section two layers, both brecciated, 198, 199; 202
in North Sew T, over Homewood Station, non-fossiliferous, on hog-back, between Connoq Cr. and Beaver Riv, 8′ to 10′ thick, 208
in Big Beav T, split by shales into 5 or 6 layers, some of them iron ore, at Marshall's mines brecciated, on Jordan's run huge masses brecciated, along Little Beaver Riv, below New Galilee, forms a ledge, . 224; 226; 227; 229
at Darlington, in one layer, . 230
in S Beav. T., on Lit Beav. Riv, minute crustaceans, at head of Little Brush run makes white lime, 240, 242
in Chip. T., massive, hard, gray, . . 244
in Brighton T, up Two-mile run, ferruginous, brecciated, 256
in Ohio T., at Smith's Ferry, replaced by iron ore nodules in shale, on Island run, hard, compact, . 264, 267

Upper Freeport Sandstone.
in Econ. T., on Crow's run, long ranges of cliffs, . 184, 185
in New Sew T, on Crow's run, makes cliffs, 186
in Pulaski T., *contains a Coal bed*, on Paved run, quarried by Mr. Smith, on Beaver, blocks on McGuire's hill, Trough Run, 194, 195; 200

Page

Upper Freeport Sandstone—*Continued.*
in North Sew T,, sandy shales on a Massive SS. base, on Beaver River; cliffs at forks of Bennett's run, huge blocks at bend of the Connoquenessing, 204, 207; 210
in Franklin T , overhanging cliffs, along Soap run, 220
in Big Beaver T., *not* massive on Little Beaver River, 229
in Darlington T (75') at Darlington, upper 30' flagstone, lower 45' massive, between these shows the hard blue silicious layer described in K (p. 343), massive on Coal run, 230, 231, 233
in Chip T. (70') on Brady's run, immense cliffs, 243
in Patt T , quarried over New Brighton, very massive, coarse, red-white, not equal to the Mah SS., at New Brighton not massive, but shaly, 248, 249
in Brighton T., on Brady's Run, huge bluffs, 251, 252
below Vanport, makes cliffs, 256
in Ohio T , Smith's Ferry, cliffs, (100') on Dry run, cliffs, (130') on Bealer's run, cliffs, 264, 267, 269

Coal, *local*, in the Mahoning Sandstone.
in Pulaski T , locally found on Paved run, 194
Lower Freeport Coal, described, 48
in Econ T., mined on Tirebaugh Run, 182
in New Sew T., slaty on Crow's run, 186, 187
in Pulas T., on Block-house run, thin and slaty; on Trough run, impure cannel, 197, 200
in N Sew (1'), south fork Bennett run, 70' above Darlington C. (dip not considered), 207
in Big Bea. T , pure coal in R. R cut, 224
in Darl T. (2' to 3'), worthless at Darlington. slaty, with streaks of Coal, on Coal run, 230, 233
in S. Beav T., good on Anderson's run; (3') brilliant on S branch of L Brush run 238, 242
in Brighton T , too thin along Two-mile run, semi-cannel immediately under Butler SS , 256; 258
in Ohio T , Smith's Ferry, bituminous slate mixed with coal, 264

Lower Freeport Limestone (Butler L.)
in Econ T , Baden station, brecciated, holds iron nodules, seen opposite steam mill, 182
in New Sew T , Crow's run, quarried, brecciated, surface rough with iron nodules, 187
in N. Sew. T (2'), south fork Bennett's run, 207
in Franklin T , Soap run, ferruginous, full of iron nodules; replaced by fossil plant shale bed, 219, 220
in Big Beav T. RR. cut, two layers both brecciated, ferruginous, 224
in S. Beav T. Brush run, iron nodules, 241
in Patt T. always ferruginous and impure, 249
in Ohio T. Smith's ferry (3') ferruginous shaley, 264

Lower Freeport Sandstone (Butler SS)
in Pul. T Trough run section, upper flaggy, lower massive, over Beaver Falls, cliffs, coarse, weathering in holes, &c., 200, 202
in New Sew. T. massive on Beaver Riv.; great blocks, 204

Page

Lower Freeport Sandstone—*Continued*
  in Patt T over New Brighton, flaggy, shaly, massive, cliffs in hill top called "Alum rocks," here mistaken for Mahoning SS, 248; 249
  in Bright. T (?) on Six-mile run, 258
  in Industry T. (100′) solid mass; (120′) 1 mile below Industry, over R. R, . 261, 262

Coal local
  in Patt. T New Brighton section, sometimes seen under L. F. S. never workable, . . 250
  in Ohio T. Smith's ferry local over Darl. C., 265

Darlington Coal bed.
  in Econ. T Remington R. R station immediately under L. F. S., 184, 185
  in New Sew T on Crow's run frequently mined, has 6″ of Cannel at top; goes under just below the forks, struck in oil well 75′ below Lower Freeport Coal, 185, 186, 187
  in Roch. T, (14″) above the mouth of Beaver Riv., 192
  in Pulas T, on Paved run very pure, on Blockhouse run; along N. Branch mined; on Trough run pure, 194, 196, 198, 200
  in N. Sew T. above Beaver Falls; (2½′ to 3′) forks of Bennett's run superior to Kitt C., (3′) in Hogback ridge good, 140′—U F. L, (2½′) on Newcastle road mined, pure, good; (2½′ to 3′) on all the farms up Connoq. Creek, on Brush Cr. Newton's mines changes in 3 rods from 6″ of slate to 3′ of coal; variations in the roof, . . 204, 207, 209, 211; 212
  in Marion T workable all up the Connoq. Cr., mined at Barrisville, roof impure cannel, goes under Brush Cr just above Barrisville, . 214, 215
  in Frank T. above Cunningham's bridge, thin, pitchy; (22″) forks of Soap run, good, 95′ above Connoq. Cr.; 50′ above in the Big Bend, 217, 219, 222
  in Big Beav. T mistaken for Kitt. C. by the old Survey; near the Summit R. R., (2′) on Jordan's run, 222; 224, 225; 228
  at Darlington (1½′), (12′) 3 miles below Darl. Coal run, 231, 232; 233
  in S. Beav. T., Anderson's run 10″ to 15″ cannel upon 12″ bituminous, 4′ to 5′ impure cannel shale, . 238
  in Chip. T on Brady's run too thin; (1′ 4″) ¾ m from Darlington; (28″) 1½ m. above Beaver Falls station, ... 243; 245, 246
  in Patt. T. over New Brighton pure but thin; free from crusts; (15″ to 28″) Brady's run mined, pure brillant, . 248; 250, 251
  in Bright. T (18″) Brady's run 45′ above Kitt. C, . . . 252
  in Ohio T. Smith's ferry (2′) bright, good, extensively mined below Smith's ferry, very pure, below Island run 140′ under U. F C, supplies oil wells; called "Sulphur Vein" at Smith's Ferry, goes under Bealer's run at Ohio line, . 265; 266; 269

Darlington Underclay.
  in Frank. T. forks of Soap run, thick at Musser's, . . . 219
  in Bright T east branch Brady's run, thick and pure, ... 258
  in Ohio T Smith's ferry, brick works (5′), . 265

Johnstown Cement Bed.
  in Frank. T. iron ore, . 222

Page

Darlington Shales,
  in Pulas. T Paved run, iron ore, 194
Darlington Plant Bed, 234
Kittanning Coal
  in Econ. T. uses from Ohio water at mouth of Crow's run, poor, 179, 184
  in New Sew. T mined at Freedom; worthless on Dutchman's run, 190
  in Roch. T. above Freedom, bad; in Roch. gas well 180′ below U. F. C.; extensively mined at McKinley's run and Whistler's run, 190; 191; 192
  in Pulas. T mined on Paved run, superior coal at Terra Cotta works; opposite Butler Station, Beav. Riv.; 15′ under forks of Blockhouse run, at Reaver Falls, 194, 195; 196, 197, 202
  in N. Sew. T. in ravine above Beaver Falls; (3′) pretty good, 35′ under Darl C. forks at Bennett's run, mined 85′ over Ferr L. Hazen's bridge, unnoticed by the farmers, 204, 207, 209; 211
  in Marion T workable half way up Connoq Cr. and up Brush Cr, 214
  in Frank T. Soap run "18″ vein" 35′ under Darl C, rich and oily, sinks at mouth of Camp run, . . 219; 220, 221
  in Big Beav T. (18″) 30′ under Darl C great under-clay, (22″) 25′ under Dal C, (2′) abandoned at Homewood, (20″) good on Jordan's run, 222; 224; 225, 228
  in Darl T (2′ maximum) around Darlington, pitchy, bright, pure, (2′) Coal run, (2½′) 1½ m S. E of Enon good, 231; 234, 237
  in S. Beav. T. Anderson's run, mined, pure, brilliant, pitchy, eroded by S S. on Little Beaver, (2′) 180′ below U. F. C. Brush run, 238, 239; 240
  in Chip. T. (2½′) mined on Brady's run, large sulphur binders, . 243
  in Patt T mined along R. R. ¾ m. above Beaver Falls station, two benches, mined, New Brighton, pure, (3′) Thomas' branch, Brady's run, bottom impure, 40′ below Darl. C. where it issues from Brady's run just below West branch; 2½′ to 3′ Brady's run, (2′, 8″) mined at Bridgewater, 247, 248, 251, 252, 254
  in Industry T. Six-mile run (3′, 4″) good, oily, brilliant, (4′) at Industry, bottom layer cannel, thickens to 5′, . . . 259, 260
  in Ohio T. 40′ above Ohio Riv. at the East township line, 100′ at Smith's ferry, (2½′) "sulphur vein" Smith's ferry "3′ vein," (2½′ to 3′) Island run, Ohio line, 262, 265, 266, 269
Kittanning Underclay
  in Econ T. on Crow's run, ... 184
  in New Sew. T. good at Freedom, 190
  in Roch T. good above mouth of Beaver, Whistler's run, 193, 193
  in Pulas T very good on Paved run, superior at Terracotta works on Beaver and Ohio Rivers, at Butler station, 195, 196
  in N. Sew. T. on Bennett's run, 206
  in Marion T (6′) good up Brush Cr, 215
  in Frank T Soap run section, large and pure, 220, 221
  in Big Beav T. fire clay, 222
  at Darlington, great bed 10′ visible, 231
  in S. Beav T (10′) on Brush run, . . 240
  in Chip. T. very pure on Brady's run, 243

Page

Kittanning Underclay—*Continued*
- in Bright T. thick and pure on east branch of Brady's run; good at Vanport, 253; 256
- in Ohio T. Smith's ferry (10') good 7' mined at brick works, 265

Kittanning Sandstone.
- in Pulas. T. massive on Trough run, 200
- below Vanport, cuts out the Buhrstone iron ore, . 256
- in Industry township very massive cliffs on Six-mile run, . 259

Ferriferous Limestone (Vanport L.) described, 60
- in Roch. T first appearance on the Ohio Riv. mouth of Whistler's run, fossiliferous, shrivelled and wavy, 193
- in Pulas T. on Paved run, split into three by shales, crowded with fossils; on Beav. Riv quarried for cement; on Trough run (6') varies to 2', fossils, *cone-in-cone*, 194; 196, 200
- in N. Sew. T. on Beaver Riv. *cone-in-cone*, (23' thick) at Hazen's bridge, making cliffs; cliffs at head of Connoq. Cr with fallen blocks as big as a house, 205, 209; 210
- in Frank. T. (15') opposite New Sewickley on Connoq Cr full of fossils; thins down to 3' and to 0' in ½ m becoming impure but still full of fossils, full of iron ore nodules, 217; 218, 221
- in Big Beav. T *absent* over Homewood S. S, . 225
- in Patt. T New Brighton *cone-in-cone*, varies rapidly 18" to 6"; on Brady's run two layers enclosing 3" of shale, 248; 250; 251
- in Bright T. impure, *cone-in-cone*; Two-mile run mouth, thickens in 3 m. from 2' to 15', (11½') at Vanport quarries four layers of different qualities, (18') Vanport richly fossilliferous, below Vanporte covered by drift terraces, 253; 254, 255, 256
- in Industry T. (15') under Kitt. S S. south side Ohio Riv, 259
- at the Ohio line, issues from the terrace, fossilliferous, *cone-in-cone*, 267

Interval below Ferriferous Limestone.
- in N Sew T Clarion and Brookville series 160' thick cut out and replaced by the massive Homewood SS. in a distance of 3 m., 210

Black Shales under Ferriferous Limestone.
- in N. Sew T., ravine above Beav. Riv. Falls, full of fossils, 205
- at New Brighton, very fossiliferous, . . 250
- in Bright. T., east branch Brady's run, full of fossils, 253

Clarion Coal
- in Pulas. T. (1' to 2') in cliffs of Trough run, impure, . . 201
- in N. Sew. T (1½') bend of Connoq. Cr., pure and good; at water level, mouth of Brush Cr.; 140' below Darl. C., . . 210, 211
- in Frank T., on Connoq. Cr., good, slaty at top, . . . 218
- in Patt T., opposite Beaver Falls, . . . 250

Brookville Coal.
- in New Sew T,, bend of Connoq. Cr., . 210
- in Chip T. (4' 9"), R R, 1½ m. above Beaver Falls station, . 246
- in Patt. T (6"), at New Brighton becomes 3' in ½ m., 250
- in Bright. T., E. branch Brady's run, 10' above Piedmont S. S, 253

Piedmont (Upper Homewood) Sandstone, described, 65; 67
- in Pulas. T., Beaver Falls, shows at water level, mouth of Trough run, solid across river; cross bedded, trunks of trees, 199; 201; 203

Page

in N. Sew. T., on Beaver river, cliffs, on Bennett's run, cliffs, solid, hazle-nut conglomerate; pebbles in it on Bennett's run, Homewood station, type locality, 150′ thick, high cliffs, 205, 206, 208
in Big Beav. T, Homewood station, great local deposit; mouth of Wallace's run, high cliffs, ancient sea beach, 225, 229
in Chip T, R R. station, 246, 247
in Patt T, at New Brighton, pits and furrows in it, 250
in Bright T., in bed of E branch Brady's run, 253
in Ohio T., "sculptured rock" Indian drawings; curiously eroded at the falls of little Beaver, Ohio line, 265, 267

Shales under Piedmont Sandstone
up the Beaver River, thin rapidly from 80′ to 20′, 225

Mount Savage Coal, described, 68
in Big Beav T, . 225

Porter Coal, and Lower Porter Coal
at Darlington (mistaken for Sharon Coal), 160′ to 170′ below the Kitt C, 231

Mercer Limestone (Lower Wurtemberg L), discussed and described, 68
in New Sew. T., Hazen's bridge, perhaps absent, 209, 211

Pottsville (Connoquenessing) Sandstone (Lower Homewood SS.) No XII (Massillon S. S. ?), . 65, 69
in N. Sew. T, at Hazen's bridge, under water, 209
in Big Beav. T., on Beaver River, thickens rapidly; on Connoq. Cr. cliffs, 225, 226
in Ohio T., Smith's ferry, oil wells, driller's "glass sand," 270, 271, 272

Sharon Coal series, and bed, and shales, . . 66, 70
on the Little Beaver, probably absent from the oil wells, 231

Cuyahoga Shale of Ohio.
in N. Sew. T., represented on the Beaver Riv and in the Smith's ferry wells, . . 206; 272

Berea Grit of Ohio.
in N Sew. T., holds pebbles in oil well above Beaver Falls, . 206

Pocono Sandstone
on the Beav Riv and in the Smith's ferry wells, 206, 271

C.---NOMINAL INDEX TO Q.

Persons, Places, Rivers, Mills, Mines, &c.

Page.
Adams township, Butler Co , 32
Ætna furnace, Rolling mill, Pittsburgh, 84,87,46,156
Aiken (Mr.) coal mine ; old lime kiln, 28,172,173
Allen (Mr) coal mine, mill, 61,126,117,125
Allegheny City, County; river, 29,33;141;3,146,156
Alston farm, 169
Alum rocks, 249
Anderson (Mr.) coal mine, 111
Anderson's run, 238,244
Arms (Mr) coal mine, 269
Baden, Beaver County, 48
Baden station, P. F. W. & C. R W., 182,183
Bailie (Mr.) coal mine, 148
Bailie Bros.' Iron works, 147,148
Bakerstown, 162
Balie's tavern, 175
Bandy (Mr), 144
Barnes (S & Co), coal works, fire clay works, 192,193,59,193
Barret (Mr), 197
Barnisville P O., 212,215
Bartley (Mr.) old coal mine, 133
Baxter (Mr) coal mine, 212
Bealer's run, 269
Beam (George) coal mine, 113,115
Beatly (Mr) coal mine, 68
Beaver (town), county; river, 11,13;179,3,4,6,14,191,203,204,208
Beaver Falls, 4,10,14,38,48,58,63,67,199,205,207
Beaver Falls gas works; R. R. station, 203,246,247
Beaver river oil company, 253
Beaver township, Beaver Co , 238
Beaver and Pittsburgh road, 177,178,180
Bellevue, 12,175,254
Bennett's run, 204,206,207
Bentley (Mr.) coal mine, 196
Berry (Mr.) old coal mine, 182
Bieber (Mr.) coal mine, 120
Big Beaver township, Beaver Co,, 222
"Big Knob," 27,30,189
Blackstock's (Mrs) coal drift, 82
Block House run, 15,193,196,197,198
Blim (Mr); coal mine, 215,212
Book (Mr.) coal mine, 181
Boggs (Mr.) coal mine, 109
Bonzo (Mr.) coal mine, 212
Boote (Mr.) coal mine, 212

Page
Bower (Mr), 171
Boyer (Mr.), coal mine, 114
Brady's run, 5,44,50,63,82,238,242,252,253
Breakneck creek, 5,48,75,76,104,162,170
Bredin (Joseph) coal works; Dr., coal mine, 128, 131
Brewer (Mr.) coal bank, 46,150
Bridgewater, 15,59,192,254
Briggs (Mr), coal mine, 259, 260,261
Brighton township, Beaver Co., 251
Brinker's mill, station, 133, 136,147
Broad run, 213
Bromley (Mr.) coal mine, 254
Brown (Mrs.), old coal mine; Mr., coal mine, 28,174; 241
Brown's mill, 107
Brush creek, 5,36,56,73,74,170,171,185,188,203,211,218
Bryon (Mr.), fire brick works, 190
Buckeye hotel, 168
Buffalo Furnace, 94,138
Buffalo township, Butler Co., 87,127
Buhl's bridge, 109,110
Bull creek, 3,5,45,78,80,87,136,141,142,145
Burke's mill, 141
Burns (Mr), old coal mine, 188,189
Burnot's Island, 168
Burr (Mr.), coal mine, 106,115
Butcher's run, 4,28,127,128,163,164,166
Burtner (Mr), coal mine, 142
Burtt (Mr), coal mine, 262
Butts (Mr.), 234
Butler, court house, 5,49,129,130
Butler Branch R R.; station, 184,196
Butler and Harmony road, 117
Butler plank road, 101,157,162
Cable (Mr. D), coal mine, 125; 128
Camp run, 51,216,220,221
Campbell (Mr.), 155
Carr (Mr), 139
Carbon Centre, 134
Carll (J. F.), 17
Carson (Mr.), limestone quarry, 155
Caspar (John), old coal mine, 188
Crab run, 122,126
Cranberry twp., Butler Co., 71
Cretz (Mr), 155
Critchlow (Mr), 106
Crow's run, 4,35,178,180,184,185,186,187
Crouse's run, 161
Chamberlain (& Mendenhall), 194
Chance (Mr), Report on Beaver River, 208, 222
Chantler Well, No 1, 87
Cheeny (Mr.), coal mine, 268

Page
Chippewa twp., Beaver Co., 44,243
Clark (Mr.), coal mine, 235
Clark's run, section, 223,213
Clayton (Mr.), coal mine, 246
Clearfield twp., Butler Co., 19,136
Clinton twp., Butler Co., 21, 51; 19
Coal run, 75,134,231,235
Coale (Mr.), 16
Collins (Mr.), coal mine, Mrs., 96,211
Columbia Conduit Comp'y, 150
Columbiana County, Ohio, 46
Conahay (Mr.), 154
Conway (Mr.), farm, 184
Connoquenessing creek, 3,5,16,51,69,100,208,208,209,211,216
Connoquenessing township, Butler Co., 128
Cook's station, 262
Cornplanter run, 8, 91,187
Corkson (Mr.), 183
Couch (Mr.), coal mine, 196
Critchlow (Mr.) 106
Cull (Mr.), old coal mine, 172
Culmersville, 20, 151
Cummings (Mr.), old coal works, 261,262
Cunningham's bridge, 217
Cutlery works, 15
Cypher (Peter), coal mine, 96
Dade (Mr.), coal mine, 102
Darlington township, Beaver Co., 230, 280
Davis (Mr.); coal mine, coke works; limestone quarry, 76;76,188,247, 58, 255
Davis's run; Tirebough run, 183, 184
Davidson (Mr.), coal mine, 76
Davidson's old mill, 243
Dawson (Amos); (W.), coal mine, 269;150,267
Dawson's mill; run, 146;151
Day's run, 147
Deener (Mr.), coal mine, 57, 138
Deer Creek, 3,5,20,149,153,155,162
Delano station, B. B. R. R., 96
Denny (Mr.), (Dr.), 94, 93
Denny's mill, section, 19, 93, 96, 94
Diamond (Mr.), coal mine, 150
Dickey's (Mr.), old salt works, 253
Dillsworth run, 234,237
Dipner (Mr.), coal mine, 138
Donahugh (Mr.), 242
Door run, 222
Dorseyville, 155
Dougherty (Mr.), coal mine, 52, 207
Douthitt (Mr.), old coal mine, 237
Douglass' (Mr.), coal bank, 32, 168
Doutt (Mr.) coal mine, 218

Page
Dry run, 267
Duff's run; mills, 172,176
Dunbar (Mr.), old coal mines, 76, 162
Dunlap (J.), coal mine, 244
Dunn (Mr.), limestone quarry, 255
Dutchman's run, 4,190
East Deer township, Allegheny Co., 146
Easterling (Mr.), coal mine, 135
Ebner (John), coal works, 202; 203
Economy township, Beaver Co.; Company, 11,181, 27,179; 248
Economy Society, Well No. 2, 205,208,232,248, 206
Edmonson (Mr.), coal mine, 125
Eichenhaur (Mr.), coal mine, 121, 122
Elder (Mr), coal mine; woolen mills, 239; 239
Elverson & Sherwood, terra cotta works, 12, 59; 195
Emerick's (Mr.), coal mine, 74
Emmitt (Mr.), coal mine, 22, 170,171, 22
Engle (Mr.), 218,259
Enon; Enon Valley, station, 237; 86; 237
Evans (Mr.); coal mine, mill; oil well record, 109, 196; 110; 110
Evansburg, 109,115
Evergreen, 20,167
Excelcior Oil Company, 270
Fairview, 268
Fallston bridge, 250
Fawn township, Allegheny County, 141
Fell (Mr.), coal mine, 254, 191
Ferguson (Mr.); old coal mine, 198; 238
Fellerman (Mr.), farm, 204
Fiedler, (Mr), 115,276
Fink's run, 179
Finlen (Patten, Swan & Co.), 260
Fire brick works, 59
Fish (Mr), coal mine, quarry, 196; 197
Fisher (Geo.), coal mine, 102,103; 134
Flemming (Mr.), 91
Flick (Mr), 162
Fontaine (Prof W. M.), 65
Ford No 1 oil well, 134
Forward township, Butler Co., 104
Frank (Mr), coal mine, 243
Franklin township, Allegheny Co.; Beaver Co., 172, 216
Franklin's old mill, 155
Frazier's mill, oil well, 99; 99
Fredricktown, Ohio, 6
Freed (Mr.), 207
Freedom, 190
Freeport, 3,28
Fumbell (Mr.), coal mine, 220
Funkhauser (Mr.), coal mine, 196
Galloway (Mr.), coal mine, 126

Page.

Garvin (J. S.), coal mine, 242

Georgetown, 11,32

Gibson (Mr.), 157,158,257

Gilliland (Mr.), old coal mine, 80

Girtie's run, 4,20,29,157,163,167

Glade creek, mills, 5,78,79,81,104,107,162, 81

Glass ("'Squire"), coal mine, 196

Glasgow,

Goehring (Mr.), quarry, 188

Goff (Mr.), 166

Goldinger (Mr.), 145

Gorle (Mr.), old coal mine, 207

Goss (Mr.), coal mine, 29

Gourd run, 20

Gourdhead run, 87,161,158

Graham (Mathew), 36,78,74,171,213

Graham's mill, 73,74

Gray's mill, 151

Grinder's (Mr.) coal mine, 83

Grier's (Mr.), coal mine, 95

Gross' (Mr.), old coal mine, 180

Hains' (Mr.), coal mine, 85,74

Hall (Chas. E.), 56

Hall (Mr.), coal mine, 244

Hampton township, Allegheny Co., 20,158

Harbisson (Mr.), run, 247, 246

Hare (Mr.), coal mine, 143

Harkins (Mr.), shaft, saw mill, 188, 188

Harmersville, 4,152

Harmony; and Butler road, 5,7,13,51,57,58,112,116; 117

Harmony tract, 182

Harris (Mr.), 200

Hart (C. E.); oil wells; record, 81,132, 87, 81

Hartford (Mr.), coal mine, 241

Hartman (Mr.), 246

Hartshorne (Mr.), coal mine, 285,286,237

Harlung (Mrs.), coal mine, 95

Hartzell (Mr.), 75

Hayes' (Mr.), coal mine; mill, 79, 80

Hays' (Mr.), old coal mine, 79

Hayesville, 38,165

Hazen (Mr.); bridge, mill, 207,208,211, 6,21,209; 69

Heids' (Mr.), coal mine, bridge, 107; 106

Hemphill's (S.), coal mine, 83

Henrici & Baker, 232

Herman, Oil Co. well, 136, 136

Herron (J. A.), 158,160,159

Hickey (Mr.), coal mine, 216

Hieber (Mr.), coal mine, 157,158

Hill (Mr.), coal mine, 78; 144

Hite's (Mr.), drift; run, 148, 45, 29,149

	Page.
Hitestown,	45,148,156
Hodge (J T.),	66
Hoenick (Mr.), farm,	179
Hoffner (Mr.), coal mine,	128
Holstead (Mr.), drift,	84, 85
Holmes (Mr), coke works,	58
Homewood, furnace, station,	21,51,210,229; 60,69,208,225; 60,69,207,208
Hoopes (Mr),	200
Howe (Mr.), coal mine,	250
Hulmes & Bro , coal mine,	247
Humes (Mr.), oil wells,	137
Hunter (Mr.),	108
Indiana township, Allegheny Co.,	152
Industry township, Beaver Co.; salt works,	59,61,259,260
Irwin (Mr.), coal mine,	158,209
Island run,	267
Jack's run,	4,166,167
Jackson (Mr), coal mine,	211,239; 95
Jackson township, Butler Co ,	112
Jefferson Center, twp Butler Co ,	99,100, 97
Johnson (Mr), coal mine,	158,225,242
Jones' bridge,	70
Jordan's run, section,	227,227
Karns' branch, Connoquenessing Cr.,	127,131
Kean's (Mr), coal mine,	52
Kearn's (Mr), coal mine; city,	132,131
Keeling (Mr), coal mine,	134
Kennedy (Mr.); farm; coal mine,	101; 207,144,208
"Kenwood,"	12
Ketterer (Mr), coal mine,	216
Kiefer (Mr.), old coal mine,	122
Kier Bros.,	224
Killbuck run,	4,27,37,172,174,175,176
King (Mr), coal mine,	95
Kinker (Mr),	120
Kittanning Coal Company, old drift,	140
Knouff (Mr), coal mine,	111
Koch (Mr), old coal mine,	218,120
Kramer (Mr), coal mine,	137
Krebs (Mr), coal mine,	75
Krumpy (Mr), coal mine,	88
Lacock (Mr), coal mine,	191
Laferty (Mr.),	235
Lancaster township, Butler Co ,	118
Lancaster and Beaver River Oil Co.,	258
Lardin's (Mr.), coal mine; mill,	45, 84; 84
Lardin's branch, Bull Cr.,	82,146
Lardintown; gas well,	45,83,84: 83, 84
Larkin (Mr.), coal mine,	182
Lavery (Mr), old coal mine,	101
Layng (Mr),	166

Page
Lee (Mr), coal mine, 182
Lefever (Mr.), . 153
Legionville run, 4,182
Lesley (Prof J. P.), 39, 68
Leslie (Mr.), coal mine, 143
Lesquereux (Prof. Leo), 250
Likens (Mr), coal mine, 115
Lister (Mr), coal opening, 258
Little Buffalo Creek, 3,37,87, 91
Little Beaver Creek, 3,130,266,273
Lloyd's (Mr), coal opening, 78
Log run, 152
Long run, 3, 19, 139
Lord (Mr), coal mine, 193
Lovell (Mr), coal mine, 35, 187,188
Lowrie's run, 4,172,174,175
Loyd (Mr), coal mine, 78
Luntz (Mr.); coal mine, sandstone quarry, 115; 114,262, 188
Lyon (Mrs), coal mine; Mr , coal mine, 135, 268
Madden's (Daniel), coal mine, run, 237, 287
Mahan's (J. B), oil well, 81
Mahoning, 16
Main (Mrs.), 209
Mansfield (Mr. I. S.), & Co., 52,53,56,232,234,233
Marborough (Mr). coal opening, 75; 76
Marion township, Beaver Co., 214
Marshall (Mr.), coal mine, 111,146,152,153,226
Marshall township, Allegheny Co., 171
Martin (Joseph), coal works, 20,46,126,151,152,230,231
May (Mr.), sandstone quarry, 109
Mayfield station, 247
Measel (Mr.), coal mine, 118
Mechanicsville, 56,218
Mendenhall (Chamberlain &), 194
Mercer (Mr.), coal mine, . 214,215
Mershing (Mr.), coal mine, 108
Metz (Mr), 221
Meyers (Mrs), coal mine, 159
McCandless (Mr.), coal mine; limestone quarry, 124,139,125
McCandless twp , Allegheny Co., 167
McCarter (Mrs.), 44,244,245
McClelland (Mr), . . 139,197
McClure (Mr.), coal mine; stone quarry, 237,227
McClure township, Allegheny Co., 163
McCready (Mr), 223,225
McCurdy (Mr.), coal mine, 92
McDaniel (Mr.), coal mine, 212,213.214,215
McDevit (Mr.), coal mines, . 137,138
McDode (Mr.), coal mine, 241
McDonald's store, 180
McDowell (Mr); run, 145, 144,145

Page.
McGaffich (Mr), coal mine, 258; 257,259
McGregor (Mr.), farm, 85, 86
McGuire (Mr), tract, 199,202,203
McJunkin (Judge), coal mine, 136
McKane (Mr.), . 177
McKinley's run, . 192
McKinney (Dr.), . 256
McLaughlin's coal mine; run, 192, 267
McMahon's coal mine, 245
McMillan's coal opening, 240
McMullen's coal mine, 134
McPherson's branch, 179,180
McQuinston (Mr.), coal mine, 129, 217
Middlesex township, Butler Co., 78
Middleton (Mr), 250,257
Miller (Mr.), drift, 88,157
Millerstown, . . 82,146
Millerson (Mr.), coal mine, 126
Mitchell & Co, fire brick works, . 256
Moder (Mr.), stone quarry, . . . 124
Moore (Mr.), coal mine, 245; 193,241,261
Moon (Mr.), 168
Monroe, R. R station, . 90, 88,89,91
Montour's run, 161,168
Montgomery (J.) coal opening, branch, 85,86, 85,86
Morgan (Mr.); coal mine, 257, 252
Morris (Mr.), Coal mine, 83
Morrow (Mr), old coal mine, 138,139
Moulter (Mr.), coal works, 192
Mowry's (Mr), coal opening, . . .79
Muntz's (Mr.), coal mine; well, 130,133, 129; 130
Mullen & Co, coal mine, 236
Musgrave, (Mr), 184
Musser (John), coal mine, 219
Neely (Mr.), Miss, 169, 166
Negley's run, 141
Nevill (Mr), coal mine, 257,261
Newberry (Dr.), . 10,16,34,36,47,49,53,58,70
Newton's (Mr.), coal bank, run, . 56,212; 215
Newman's branch, 127,131
New Brighton, 5,11,14,39,48,63,67,198,199,204
New Castle road, 208,211
New Gallilee, . 14,227,228,232
New Lisbon and Beaver road, 257
New Sewickley township, Beaver Co., P. O, 27,36,185,203; 211
Neblock (Mr.), old coal mine, 243
Neiss (Mr.), coal mine, 86; 86
Nine mile house, . . 157
North Sewickley Academy, 211
North Sewickley township, Beaver County, 203
Noss's saw mill, . . 188

Page
Nye (Mr.), coal mine, 218
Ohio township, Allegheny Co.; Beaver Co., river, 174, 262, 4, 14
Ohioville, 268 269, 267, 271
Old Winfield Furnace, 49
Paper Mill at Beaver Falls, 4
Park's (Mr.), coal mine, mill, 32; 77, 76
Passavant (Mr.), 117
Pattens, Finlens, Swan & Co., 269
Patterson (Mr.), coal mine, run, 228; 101
Patterson township, Beaver Co., 247
Paved run, 61, 194
Peffer's bridge, 112
Penn township, Butler Co., 100
Pennsylvania creek, 6
Perrysville; plank road, 167, 166
Peterson & Co., salt works, 147
Phillis (Mr.), coal mine, 262
Phillipsburg, 11
Pickle (Mr.), coal mine, 86, 287
Pierce's branch, Pine Creek, 169, 170
Pierce's mill, 169
Pine Creek, 4, 5, 20, 28, 37, 155, 158, 162, 167, 170, 174, 216
Pine township, Allegheny Co., 170
Pittsburg, 12
P., F. W. & C. R. W., 13, 14, 20, 223
Pittsburg & Northwestern R. R., 171
Platt (Mr.), coal mine, 251
Platt (Mr. Franklin,) 28
Potter (Mr.), coal mine, 261
Powell (Mr.), old coal mine, 214
Powers (Mr.), 255
Pugh (Mr.), coal mine, 142; 148
Pughtown, 20
Pulaski township, Beaver Co., 193, 204
Raccoon Creek, 16
Ramsey (Mr,), 15, 166, 205
Ray (Mr.), old coal mine, 254
Reed (Mr.), coal mine, 261
Remington station, 184
Renfrew's (Mr.); old coal mine; mills, 103, 128; 104; 105, 127
Reserve township, Allegheny Co., 163
Rhodes (Mr.), old coal mine, 244
Richards (Mr.), 91
Richland township, Allegheny Co., 162
Rieth (Mr,), coal mine, 88
Roan (Mr.), old coal mine, 75
Robertson's run, 147
Robinson's (Mrs.) farm, (Mr.), run. 185; 207; 147
Rochester; township, Beaver Co.; road, 4, 11, 190, 254; 190, 191
Rochester, Tumbler Co., 191
Rodenbaugh (Mrs.), 166, 167

Page
Rogers (Prof. H. D.), 86,66,126,250
Ross (Mr.), coal mine, twp., Allegheny Co., 248, 166
Rough run, 3,57,59,91,93,137
Salt works, 147
Sample (Mr.), coal mine, 116
Sanor (Mr.); coal mine, 245, 244
Sardintown, 20
Sarver (Mr.); run, 169, 19, 88, 89
Sawney's run, 95
Saxonburg, 91
Saxon City, 19, 20, 96
Schuring (Mr.), farm, 173
Scholar's run, 112,118
Scott (Mr), 226
Seidel's mill, 117
Semiconnon creek, 35,125
Severn (Mr), limestone quarry, 255, 256
Sewickley township, Allegheny Co.; village, 177; 177
Sewickley Creek, 3,4,171,172,177,178,179,181
Shaffner (Mr), coal mine, 128
Shaler township, Allegheny Co., 45, 155
Shantz (Mr), coal mines, 114
Sharpsburg, 46, 84,156
Shaw's (Mr.), coal mine; mills; run; town, 156, 157, 158, 117, 46
Shenango, 16
Sherwood (Elverson &), 59, 195
Simon (Mr.), coal mine, 149; 29
Simmons (Mr.), coal mine, 95, 144
Six-mile run, 61, 259
Slater (Mr.), coal mine, 107
Slippery Rock Creek, 6,51,68,69,119,208,226
Smith (Mr), coal works; farm; stone quarry, 192,196,248,186,187,271,195
Smith (William), 273
Smith's Ferry; oil territory, 88,39,52,64,67,268,270,269
Soap run, 218.219
Spawn (Mr.), coal mine, 136
Spence's (Mr), coal mines, 78
Spring Garden run, 28,29,163,164
Spring House run, 175
Stamm's (Mr.), coal mine, 216,221
State line, coal company, 38; 236
Steele (Mr.), coal mine, 35
Steel (Mrs.), coal mine, 187
Stevenson (Prof.), 30
Stevenson (Robert), old mine, 183
Stewart (Mr.), 115
Stickle (Mr.), old coal mine, 229
Stoup (Mr.), 78
Straw (Mr.), 157
Sturgeon (Mr.), old coal mine, 288
Summit township, Butler Co.; cut brick-works, 132; 46, 226

Page.
Sunset station, B. Br. R R., 135
Swan (Patten, Finlens & Co.), 270
Swick (Mr), coal mine, 212,219
Syracuse Coal Company, 284
Tarentum, 8,48,86,141,147,150
Taylor (Mr.), old coal mine, 243
Terra cotta-works, 12, 195
Thomas (Mr.), run, 197, 245,251
Thompson (Mr.), stone quarry, 175
Thorn Creek, 5,97, 100
Tice (Mr.), coal mine, 238
Tinnis (Mrs.), coal mine, 242
Tivebaugh run, 3,4,182
Todd & Company coal-works, 236
"Town rocks," 104
Trough run, 49,199,201
Tygarts (Mr.), limestone quarry, 61,256,282
Udick's (Mr.), coal mine, 52,266
Ullery (Mr), coal mine, 212
Unionville, 189
Vandevor (Mr), coal mine, 75, 174
Vanport, 15,61,63,255
Wagner (Mr.), coal mine, 97
Waldo & Bros., 130,132
Walker & Co , fire brick-works, 264,265
Walker's fording, 98
Wall (Mr) ; coal mine, 111, 112
Wall Rose P O., 180
Wallace's run, 13,229
Walnut bottom run, 15
Walton (Mr.) ; coal mine, 258, 257
Warner (Mr.), 169
Watts (Mr), coal mine, 268
Watson (Mr.), coal mine, 45
Weaver (Mr.), coal mine, 105
Weber (Mr), old coal mine, 155
Welsh (Alexander), coal mine, 100
Welsh Thomas, 98
West (Mr.), 215
West Deer township, Allegheny Co., 20,149
West Pennsylvania R R., 29,164
Westerman farm, 87
Wexford P. O., 171
Wahn (Wm.), coal mine, 236
White (Mr.) ; (Prof.) ; Thomas, 43, 17,65; 146
Whitestown, 126
Whistler's run, 192,193
Wible's (Mr.), coal mine, run, 158, 157
Wilging (Mr.), 262
Williams (Mr.), coal mine,
Wilson (Mr.) ; coal mine, 120,216,217, 88,125,147,240

Page.
Wilson (Webster), salt water well, 118
Winfield Furnace Company, 59,91,92,93,94,138,139,140
Winfield township, Butler Co., 91
Wolder Bros' mills, oil well, 130,132
Wood's (Mr.) coal bank, run, 85; 4,20,83,166,165,166
Woodrow (Mr.), coal mine, 144
Wolf run, 261
Wrights (Mr.), coal mine; farm, 21,26, 173
Wrigley (Mr), 67
Wurster (Mr.), coal mine, 122
Wursted & Keifer, 123
Wurtemburg, 68,69
Wurth (Prof), 46
Yellow creek, 51,53,117,118
Young (Mr.), 228
Yonker's mill, 155
Zahn (Mr.), 188,189
Zelienople, 7,56,112,116
Ziegler's (Mr.), coal mine; hill, mill, 116, 116, 113,115

D. LIST OF SECTIONS IN Q.

NOTE —The first 24 of these sections are placed as wood cuts on the first 64 pages of the Report.

The rest of them are distributed upon twenty-one page-plates in such a manner as to mutually illustrate the positions and sizes of the coal, limestone, and sandstone beds, and the variation of their interval distances apart.

Plates I to VIII contains sections from Butler County.

Plates VIII to XII contains sections from Alleghany County.

Plates XII to XXI contain sections from Beaver County.

The distribution of the sections on each plate is as follows, and in accordance with a general movement of the numbers from right to left, and otherwise with a general agreement on the page with their geographical positions on the map. But economy of space made an *exact and complete* adherence to either of these methods impossible. It will be easy for the reader to make the necessary slight readjustment.

Plate	I	contains	figs.	25,26,27,28,29,31,32,36,37,39,40,61,65,87.
"	II	"	"	30,33,34,48,56,101
"	III	"	"	38,41,42,43,45,53,55,63,64,93,97,98,100.
"	IV	"	"	46,47,51,54,77,83,84,85.
"	V	"	"	52,57,58,59,60,62,67,74.
"	VI	"	"	49,50,66,69,70,80,88,89,90,91.
"	VII	"	"	24,68,71,73,75,76,79,81,82,83,86,95,102,103.
"	VIII	"	"	72,78,92,94,96,99,102,103,104,105.
"	IX	"	"	106,107,108,109,111,112,118,119,120,124,129.
"	X	"	"	113,114,115,117,128,130,133,135,136,137.
"	XI	"	"	110,116,125,126,127,128,131,132,134,135,137,139.
"	XII	"	"	121,122,123,138,140,141,142,143.
"	XIII	"	"	144,145,147.150,164,172,173,174,184,185.
"	XIV	"	"	146,149,155,156,166,177,179,180,190,214,232.
"	XV	"	"	151,153,162,176,182,191,194,199,201,202,212,236.
"	XVI	"	"	154,158,160,163,165,166,167,168,169,178,185,186, 187
"	XVII	"	"	161,163,164,166,167,168,181,183,188,189,195,197, 200,207,215,222,226,228,230,239,240,246
"	XVIII	"	"	148,157,159,170,171,186,198,204,206,210,212,213, 216,217,236,238,242,243,248.
"	XIX	"	"	192,193,198,203,205,208,211,215,218,219,220.
"	XX	"	"	209,221,223,224,225,229,231,234.
"	XXI	"	"	227,233,235,237,241,244,245,246,247.

NOTE —The sections of *single coal beds* are printed on a scale of 10′ : 1″, reduced from original drawings of 5 feet to the inch.

The longer sections of *several coal beds* are printed on a scale of 100′ · 1″, similarly reduced one half from the originals

This is the scale used in the Geology of Pennsylvania, 1858, and in all previously published Reports of Progress of the present Second Geological Survey.

CATALOGUE OF SECTIONS GIVEN IN THIS VOLUME.

Report of Progress. Q.

NOTE.—The following symbols are used in this catalogue:—T for Township; Bt. for Butler County; A for Alleghany County, Bv for Beaver County, SS. for Sandstone.

Page
Fig. 1. Pittsburg bed at Wright's bank, in Franklin T., A., . 21
" 2 Pittsburg bed, Emmitt's bank, Penn T, A, 22
" 3 Barren Measures, 570′ to 680′, in Alleghany County, 24
" 4. Barren Measures, 320′, at Freeport, Armstrong County, 24
Elk Lick bed, Aiken's mine, Franklin T line, 28
Bakerstown (Coleman's) bed, Douglass' bank, Richland T, A, 32
Brush Creek (Gallitzen) bed, Hain's bank, Brush Creek, A, 35
" 6. Buffalo ss down the Freeport bed, 177′, Pine Creek, A., 37
" 7. Lower Productive Coal Measures, 378′, at Kittanning, 40
" 8. Lower Productive Coal Measures, 384′, at New Brighton, 41
" 9. Lower Productive Coal Measures, 285½′, at Smith's Ferry, 42
" 10. Upper Freeport bed, McCarter's bank, Chippewa T, Bv., 44
" 11 Upper Freeport bed, Lardin's bank, Clinton T, Bt, 45
" 12. Upper Freeport bed, Hite's bank, near Hitestown, 45
" 13 Upper Freeport bed, Watson's bank, Shaler T., A, 45
" 14. Darlington (U Kitt) bed along the Connoquenessing creek, 51
" 15. Darlington (U. Kitt) bed along the Beaver river, 51
" 16. Darlington (U Kitt.) bed along the Ohio river, 52
" 17. Darlington bed, Mansfield's mine, below Darlington, 52
" 18 Kittanning (L Kitt) bed, Deener's bank, Clearfield T., Bt., 57
" 19. Kittanning (L Kitt) bed, at New Brighton, Beaver Falls, 58
" 20 Ferriferous Limestone, at New Brighton, 61
" 21 Ferriferous Limestone, Tygart's quarry, at Vanporte, 61
" 22. Brookville bed, 2½ miles above Beaver Falls, 63
" 23 Beaver River Series, (Group,) 197′ to 257′, Beaver River, 66
24. Connoquenessing (Lower Homewood) Sandstone Shales, 12′ 6″, 70

1. Sections in Cranberry T, Butler County

" 25. Upper Freeport Coal, at Graham's Mill, 21′, . . 73
" 26 Brush Creek Limestone and Coal, Hain's bank, 13½, 74
" 27. Brush Creek Limestone and Coal, Emmerick's bank, 17′, 74

2. Sections in Adams T., Butler County.

" 28. Upper Freeport Coal, Marborough's, 7½′, 75
" 29. Brush Creek Coal, Davis', 60′, . 76
" 30. Bakerstown Coal, Park's mill, 200′, 76
" 31. Upper Freeport Coal, Loyd's bank, 16½′, 78

3. Sections in Middlesex T., Butler County.

" 32. Bakerstown Coal, Mowry's bank, 12′ to 6′, . . . 79
" 33. Elk Lick Coal down to Bakerstown Coal, Hays', 191′, . 79
" 34 Crinoidal L. down to Mahoning SS, Hays' mill, 240′, . 80
" 35 Oil Well Record from U F. C down, C E Hart's, 1,880′, 81

4 Sections in Clinton T., Butler County.

Page
Fig. 36. Upper Freeport Coal, Blackstock's mine, 12′, . . . 82
" 37. Upper Freeport Coal, Hemphill's mine, 40′, 83
" 38. Upper Freeport Coal, Morris's mine, 5′, 83
" 39. Upper Freeport Coal, I. Lardin's mine, 14′, 84
" 40 Upper Freeport Coal, Holstead's mine, 42′, 84
" 41. Upper Freeport Coal, Wood's mine, 13′, 85
" 42 Upper Freeport Coal, below Wood's mine, 9½′, 86
" 43. Upper Freeport Coal, down, Bull Creek, 36′, 86
" 44 Oil Well Record, Choutler well, Westerman farm, . . 87

5 Sections in Buffalo T, Butler County

" 45 Upper Freeport Coal, Miller's mine, 32′, 88
" 46 Buffalo SS down to U F. C., Monroeville, 194′, 89
" 47. Mahoning SS down to L F. C., below Monroe, 127′, 90
" 48 Buffalo SS down to Darlington Coal, below Buffalo Cr, 328′, . 90

6 Sections in Winfield T, Butler County.

" 49 Ferriferous L, up and down, Rough run, 68′, . 92
50. Kittanning Coal down to Piedmont SS, old furnace, 140′, 92
" 51 Upper F. Coal down to Kitt. SS., Denny's Mill, 255′, . 94
" 52 Freeport group, Collins' bank, Swaney's run, 75′, 95

7 Sections in Jefferson T., Butler County

" 53. Upper Freeport Coal, Wagner's bank, 23½′, 97
" 54. Oil Well Record, T. Welsh's, Walker's fording, 292½, 98

8. Sections in Penn T., Butler County.

" 55. Upper Freeport Coal, A. Welsh's bank, 34½′, 101
" 56. Crinoidal L down to U. F C., Thorn creek, 455′, 101
" 57. Coleman (?) Coal down to L. F. C., Connoqueness Cr., 200′, 103

9. Sections in Forward T., Butler County.

" 58 Buffalo SS. down to L F. C., Renfrew's Mill, 197′, . 105
" 59 Buffalo SS down to U. F. C., Critchlow's, 200′, ... 106
" 60 Buffalo SS. down to U. F. C., Heid's bridge, 233′, 106
" 61. Brush Creek Coal, Heid's, 2½′, . . . 107
" 62. Buffalo SS down to L. F C, Glade's creek, 220′, 107
" 63. Upper Freeport Coal, on Glade creek, 21′, . . 108
" 64. Upper Freeport Coal, Mershing's mine, 42′, 108
" 65. Upper Freeport Coal, Boggs, Evansburg, 26½′, 109
" 66. Oil Well Record, Evans', Buhl's bridge, 626′, . . . 110
" 67. Buffalo SS. down to L. Freeport SS., Buhl's bridge, 225′, 110
" 68. Darlington (U. Kitt) Coal, Marshall's mine, 3′, . . 111
" 69. U. Freeport L down to Darlington Coal, Wall's, Anderson's bridge, 134′, . . 111

10 Sections in Jackson T., Butler County.

Page.
Fig. 70. Mahoning SS. down to Darlington Coal, Peffer's bridge, 131', 112
" 71 Darlington (U Kitt) Coal, Breakneck Creek, 12', 113
" 72 L. F Coal down to Darlington Coal, Zeigler's mill, 74½', 113
" 73 L. F Coal, Boyer's mine, Breakneck Creek, 44', 114
" 74 Brush Creek Coal down to L F. C., Luntz's bank, 150', 114
" 75. Darlington Coal, Fielder's mine, mouth of L Con Creek, 12½', 116
" 76. Darlington Coal, Sample's mine, Harmony, 30½', 116
" 77. B. Measures and L P. Coal Measures, Zeigler's Hill, Harmony, 390', 116
" 78. L. Freeport Coal, down, Zelionople, 94', . 117

11. Sections in Lancaster T, Butler County

" 79. Darlington Coal, Measel's mine, Yellow creek, 2' 9'', 118
" 80. Salt Well Record, Webster's, Wilson's, Yellow creek, 339', 118
" 81. Darlington Coal, Bieber's mine, Yellow creek mouth, 29', 119
" 82. Eichenhaur's Coal, section, 96', 121
" 83. Brush Creek Coal down to Eichenhauer's Coal, Crab run, 122

12 Sections in Connoquenessing T, Butler County

" 84. Buffalo SS down to Butler L D , Coble's mine, 285', 123
" 85. Buffalo SS. down to L. F C , McCandless' mine, 235', 124
" 86 L. Freeport Coal, McCandless' mine, 13', 124
" 87. Brush Creek Coal, Wilson's mine, Semicolon creek, 109', 125
" 88. Buffalo SS. down to U F. L , Semicolon creek, 157', . 125

13. Sections in Butler T., Butler County.

" 89 Buffalo SS down Renfrew's mills, 170', 127
" 90. Buffalo SS down to L F. C., Bredin's mines, Butcher's run, 195', 128
" 91. Coleman (?) Coal down to U F C., Hoffner's mine, 295', 128
" 92. Buffalo SS down (with borehole record) Muntz's, 288', 129
" 93 Upper Freeport C and L down, Dr. Bredin's mine, Butler, 116', 131
" 94. U F. C down to Butler (L. F.) L Forks of Con Cr., 157', 131

14. Sections in Summit T., Butler County

" 95. Kearn's Coal, (U *or* L Kitt. C.,) Kearn's branch of Con. Cr., 10', 132
" 96. Freeport Group, Brinker's mill, 75', 133
" 97. U. F C down Keeling's mine, above Brinker's mill, 104', 134
" 98. U F. C , George Fisher's mine, 3' 2'', 134
" 99 U. F C. down to Butler (L F) L Coal run, 102', 135
" 100. U F. C , Mrs Lyon's mine, Coal run branch, 23', 135
" 101. Coleman (?) Coal down to U F C , Sunset station, 165', 136

15. Sections in Clearfield T., Butler County.

" 102. L Freeport SS down to Kittanning Coal, McDavitt's, 112', 137
" 103 Butler SS. down to Kitt. Coal, Forks of Buffalo Cr., 260', 138
" 104. Kittanning Coal down to Clarion Coal, Armstrong Co. line, 105', 139
" 105. Kittanning Coal down to Ferr. L., Long's run, 68', 140

16. Sections in Fawn T., Alleghany County.

Page.
Fig. 106. Buffalo SS. down to U. F. C., Negley's run, 133', 142
" 107. Buffalo SS. down to U. F. L., Pugh's land, 180', 142
" 108. Upper Freeport Coal, Big Bull creek, Hare's mine, 12', 143
" 109. Freeport Group, Big Bull creek, Bandy's mine, 105½', 144
" 110. Freeport Group, Woodrow's mine, 101', 144
" 111. Buffalo SS. down to U. F. L., McDowell's run, 173', 145

17. Sections in East Deer T., Alleghany County.

" 112. Berlin Group (B. M.) down, Wilson mine, Robinson run, 150', 147
" 113. U. Freeport Coal, Baillie Bros.' mine, 10', 148
" 114. U. Freeport Coal, Hite's mine, Hitestown, 10', 148

18. Sections in West Deer T., Alleghany County.

" 115. U. F. C. and U. F. L., Brewer's bank, Bull creek, 16½', . 150
" 116. U. F. C., W. Dawson's mine, mouth of Brewer's run, 4', 151
" 117. U. F. C., J. Martin's mine, Big Deer Creek, 13' to 16', . 151

19. Sections in Indiana T., Alleghany County.

" 118. Pittsburgh Coal, Wm. Marshall's mine, 8', 152
" 119. Pittsburgh Coal, Johnston's mine, 7' 8'', . 153
" 120. Pittsburgh L. down to Pine Creek L., Conaghy's knob, 312', 154

20. Sections in Shaler T., Alleghany County.

" 121. U. F. Coal, Shaw's mine, Shaw's mills, 27½', . 156
" 122. U. F. Coal, Miller's mine, above Shaw's mills, 4' 8'', 157
" 123. U. F. Coal and L. down Hieber's mine, 45, . 157
" 124. Gertie's Run Coal (local) section (B. M.), 123', . 157

21. Sections in Hampton T., Alleghany County.

" 125. Buffalo SS. down to U. F. L., J. A. Harron's mine, Gourd Head run, 153', . 158
" 126. Crinoidal L. down Pine Creek, 321', . 160
" 127. Pine Creek L. down to U. F. L., Pine Creek, 184', . . 161

22. Sections in Richland T., Alleghany County.

" 128. Crinoidal L. down to Bakerstown Coal, Douglass' mine, Bakerstown, 100', ... 163

23. Sections in Reserve and McClure TT., Alleghany County.

" 129. Elk Lick Coal down below Girtie's run, mouth, 61', . . 163
" 130. Pittsburg Coal down to Crinoidal L., Spring Garden run, 320', . 164
" 131. Crinoidal L. down to Brush Creek Coal, Wood's run, 206, 165

24. Sections in Ross T., Alleghany County.

" 132. Pittsburg Coal, William's mine, 9' 10'', . . 166
" 133. Pittsburg Coal down to Pine Cr. L., Girtie's run, forks, 428½', 167

25. Sections in McCandless T., Alleghany County.

Page
Fig 134. Elk Lick Coal down to Bakerstown Coal, Pine Creek, 146′, 168
" 135. Pittsburg Coal down to Crinoidal L., Pine Cr., 385′, 169
" 136. Crinoidal L. down to Bakerstown Coal, Pierce's branch, 120′, 169

26. Section in Pine T, Alleghany County.

" 137. Pittsburg Coal down to Crinoidal L, Pine creek, 362½′, 170

27. Sections in Marshall T., Alleghany County.

28. Sections in Franklin T., Alleghany County

" 138 Elk Lick Coal down to Duff's run, 139′, 173
" 139. Pittsburgh Coal and roof, Wright's knob, 45′, 173

29 Sections in Ohio T, Alleghany County.

" 140. Crinoidal L. down to Duff's mills, 170′, 176
" 141. Morgantown SS down to Brush Creek L, Killbuck creek, 286′, 176

30 Sections in Sewickley T., Alleghany County.

" 142. Buffalo SS. down to Brush Creek Coal, McKane's, 60½′, 177
" 143 Crinoidal L. down to Mahoning SS., Big Sewickley creek, 305′, 178

31. Sections in Economy T., Beaver County.

" 144. Pine Creek L. down, Fink's branch of Big Sewickley, 103½′, 179
" 145 Crinoidal L. down to Buffalo SS, Crow's run, 303½′, 180
" 146 Brush Creek Coal and Limestone, Book's mine, 16′, 181
" 147. Crinoidal L. down to Mahoning SS., Economy, 252′, 181
" 148. L. Freeport Coal, Berry's mine, Baden Station, 60′, 182
" 149. L. Freeport Coal, Larkin's mine, below Baden Station, 22½′, 182
" 150. Crinoidal L down to U. Freeport L, Davis' run, 279′, 183
" 151. Mahoning SS. down to Kittanning Coal, Crow's run, 227′, 184
" 152. L. Freeport SS. and Darlington Coal, Conway's mine, 76′, 185

32. Sections in New Sewickley T., Beaver County

" 153. Mahoning SS. down to Kittanning Coal, Crow's run, 182′, 185
" 154. Mahoning SS. down to Butler L, Forks of Crow's run, 130′, 186
" 155. Brush Creek Coal, William Steele mine, Crow's run, 10½′, 187
" 156. Brush Creek L and Coal, Lovell's mine, Crow's run, 18′, 188
" 157. Mahoning SS. down to U. F L., Zone's mine, Unionville, 31′, 188
" 158. Barren Measures and U. F C, Rochester road, Unionville, 225′, 189
" 159 U. Freeport Coal and L, Cumming's land, Brush creek, 80′, 189
" 160. Mahoning SS down to Ohio river, Freedom, 287′, 190

33. Sections in Rochester T., Beaver County.

" 161. Kittanning Coal down to Ohio river, Freedom, 112′, 191
" 162 Darlington (U. K. C) down to Ohio river, mouth of Beaver, 148, 191
" 163 L. Freeport SS. down to Kittanning Coal, Beaver river, 92′, 192
" 164 Kittanning Coal down to Beaver river, S Barnes & Co., 126′, 192
" 165 Kittanning Coal to Ferrit. L, Moore's mines, Whistler's run, 57, 193

84. Sections in Pulaski T., Beaver County.

Page
Fig. 166. L. Freeport SS down to Beaver river, Chamberlain & Mendenhall's, 214', 194
“ 167. Butler SS down to Ferrif. L., Terra Cotta Works, 220', 195
“ 168. Kitt Coal down to Ferr L, Block-house run, 92', 196
“ 169 Mahoning SS. down to Kitt C., Barnett's mine, 205', . ' 197
“ 170. Mahoning SS. down to U F. L, Thomas' land, 62', 198
“ 171 Mahoning SS down to Block-house run, Ferguson's, 68', . 198
“ 172. Mahoning SS down Trough Run Section, McQuire's, 374', 199
“ 173 Mahoning SS. down Beaver Falls Section, Graff & Co., 414', 201

85 Sections in North Sewickley T., Beaver County

“ 174. Butler SS. down to Piedmont SS., Beaver river, 347', 204
“ 175. Oil Well Record, Economy well, Beaver Falls, 657', . 205
“ 176 Kitt C down to Beaver river, Bennett's run, 278', . 206
“ 177. L Freeport SS down to Kitt C., Robinson's mine, 80', 207
“ 178. Brush Creek Coal down to U. F L., Kennedy's, 96', . . 208
“ 179. Ferrif. L. down to Connoquenessing, Hazen's bridge, 192', . 209
“ 180 L F SS down to Conn creek, 1 mile below Hazen's mill, 324', 209
“ 181 Darlington (U. K. H) Coal, Isaac Hazen's mine, 2' 7'', . 211
“ 182. Darlington Coal down to Clarion Coal, N. Sewickley Academy, 130', 211
“ 183. Darlington Coal down to Brush creek, Blim's bank, 100', 212
“ 184 Mahoning SS. down to Darlington Coal, Barrisville, 151', 212
“ 185. Brush Creek Coal down to U. F L., Graham's, Brush creek, 94', 213
“ 186. Brush Creek Coal down to U F. L, McDaniel's mine, 100', 213

86. Sections in Marion T, Beaver County.

“ 187. L. Freeport SS. down to Brush Creek water, Mercer's mine, 103', 214
“ 188. Darlington Coal, McDaniel's mine, Barrisville, 24', . 215
“ 189. Darlington Coal on Connoquenessing creek, 2' 5'', 216

87. Sections in Franklin T, Beaver County

“ 190. Darlington Coal down to Connoq creek, N Sewickley, 237½', 216
“ 191 Darlington Coal down. Cunningham's bridge, 202', 217
“ 192. Mahoning SS. (?) down to Connoq. Cr., Soap run, 289' . 218
“ 193. Mahoning SS. (?) down to Soap run bed, 283½', 219
“ 194. U. F Coal down to Connoquenessing Cr, Camp run, 161', . 221

88. Sections in Big Beaver T, Beaver County

“ 195. Darlington Coal in the Beaver run, 3', . . . 222
“ 196. Brush Creek Coal down to Beaver river, Clark's run, 446', 223
“ 197. Darlington Coal, Johnson's mine, 1' 9', 225
“ 198. Brush Creek Coal down to U. F. L., M. Marshall's, 79', 226
“ 199 Mahoning SS down to Kitt Coal, Jordan's run, 284' 227
“ 200. Darlington Coal, Patterson's mine, 2', ... 228
“ 201 Mahoning SS down to Little Beaver, New Galilee, 248', 228

39. *Sections in Darlington T., Beaver County*

Page
Fig 202. Mahoning SS. down to Little Beaver, Darlingtin, 232′, . . 230
" 203. Mahoning SS. (?) down to Little Beaver, Mansfield's boring, &c., 287½′, 232
" 204. U Freeport Coal, Laferty's mine, 9′ 2″, 235
" 205 Brush Creek Coal down to U. F. L , Hartshorne's, 71′, . 235
" 206. U. F C down to RR. track, State Line Co.'s works, 63½′, 236

40. *Sections in South Beaver T, Beaver County.*

" 207. Kittanning Coal, Tice's mine, Darlington, 25′, 238
" 208 L. F C down to Kitt C., Sturgeon's land, 117′, 238
" 209 Mahoning SS down to Little Beaver, Elder's woolen mill, 227′, 239
" 210 Mahoning SS down to U. F L., Jackson's mine, 32½′, 239
" 211. Brush Creek Coal down to L F. C , McMillen's mine, 117′, 240
" 212. Mahoning SS. down to Butler SS , Moore's mine, 76′, 241
" 213. Mahoning SS down to U F L., Brown's land, 40½′, 241
" 214. L. Freeport Coal, Mrs. Tinnis' mine, S. Br. Brush run, 18′ 4″, 242

41 *Sections in Chippewa T, Beaver County.*

" 215. Darlington Coal down to Brady's run, Frank's mine, 67′, 243
" 216. Mahoning SS. and U F. C , Mrs. McCarter's mine, 32′, . 244
" 217. U. F C down to L. F C., Hall's bank, Darlington, 61′, 244
" 218 Darlington down to Kittanning, McMahon's mine, 83½′, 245
" 219. Barren Measures down to U. F. L , Moore's, Brady's run, 141½′, 245
" 220. Darlington Coal down to RR , Hartman's, above Beaver Falls Station, 164′, 246
" 221. Brookville (?) Coal, Harbusson's run, 4′ 9″, 246

42. *Sections in Patterson T., Beaver County.*

" 222. Kittanning Coal, Davis' mine, Hulme & Bros , 2″ 4″, 247
" 223. Mahoning SS down to Beaver run, New Brighton, 363′, 248
" 224. Butler SS down to Piedmont SS , New Brighton, No. 2, 362′, 249
" 225. Darlington Coal down to Brady's run, Fallston bridge, 162′, 251
" 226. Kittanning Coal down Platt's mine, Thomas' run, 83′, 251

43. *Sections in Brighton T, Beaver County.*

" 227 Darlington Coal down Brady's run, old mill, 95′, 252
" 228 Kittanning Coal, D. Morgan's mine, 3′, 252
" 229. Freeport SS down to Ferr L , Brady's run, west branch, 187′, 253
" 230. Kittanning Coal down to Beaver river, Brawley's mine, 128′, 254
" 231 U. F. C. down to Beaver river, Fell's hill, 285′, . 254
" 232. Ferriferous Limestone, down, 47′, 255
" 233 L. Freeport SS. down to Ohio river, Vanporte, 219′, 255
" 234 Mahoning SS. down to Two-mile run, 153′, 256
" 235 Mahoning SS. down to Six-mile run, 98 , . 257
" 236 U F C. down McGoffich's mine, 60′, 258
" 237 Mahoning SS. down Lister's land, 45′, 258

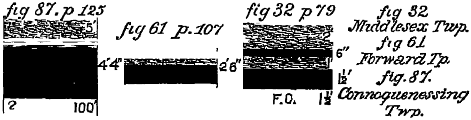
44. Sections in Industry T, Beaver County

Page
Fig. 238. U. F. C. down Engle's mine, Six-mile run, 68½', 259
" 239 Kittanning Coal, down. Howe's mine, 69', 259
" 240. Kittanning Coal, Brigg's mine, Industry, 4', 259
" 241 Buffalo (?) SS. down to Ohio river, Industry, 383½', 260
" 242. U. F. C. down. Reed's mine, Wolf run, 42½', 261
" 243 U. F. C. down. Burtt's mine, above Industry, 68', 262

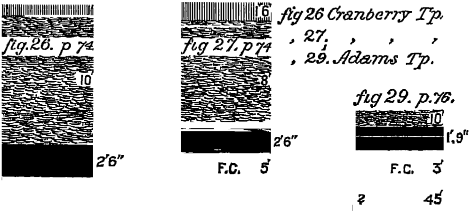
45. Sections in Ohio T, Beaver County.

" 244. Pine Creek L. down to Piedmont SS., Smith's Ferry, 457½', 263
" 245. L. Freeport SS. down to Ohio river. Smith's Ferry, Dry run, 180½', 265
" 246. L. Freeport SS. down to Ohio river. Glasgow, 177', 266
" 247. Mahoning SS. down to Piedmont SS., Little Beaver Cr., 337½', 266
" 248 Mahoning SS. down to U. F. L. Dawson's mine, Island run, 44', 267
" 249. Oil Well Record, Smith's Ferry, Piedmont SS. down, 478½', 270
" 250 Oil Well Record, Ohioville, Mahoning SS. down, 998', 272

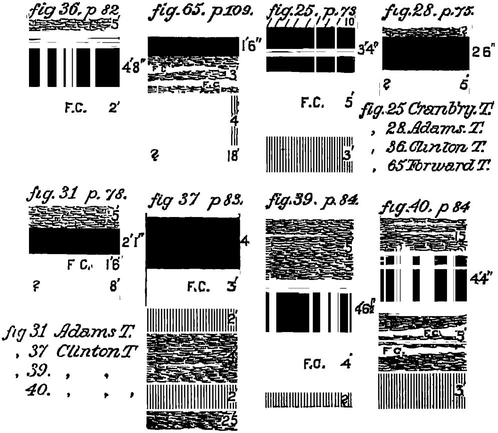
Bakerstown Coal Bed in South Butler Co.



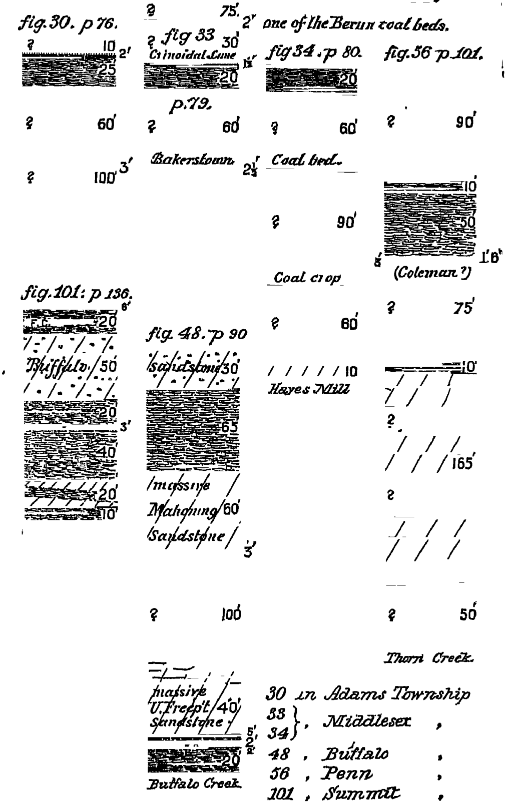
Brush Cr. Limestone and Coal Beds.



Upper Freeport Coal and Limestone.



Vertical Sections in Butler County.



30 in Adams Township
33 }
34 } , Middlesex ,
48 , Buffalo ,
56 , Penn ,
101 , Summit ,

Upper Freeport Coal & Lime. S. Butler Co.

fig 93 p.131

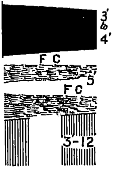


fig 97. p 134

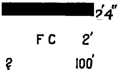


fig 98 p 134

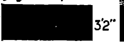


fig 100 p.135.

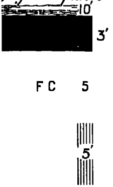


fig 38
, 41
, 42 } Clinton Twp
. 43

fig. 64 p 108.

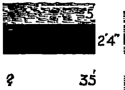


fig 63 p 108.

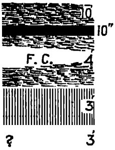


fig 55 p 101.

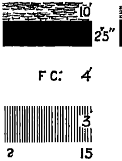


fig. 53 p 97.

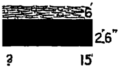


fig. 41. p. 85.

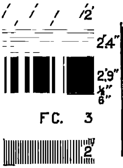


fig. 42 p 86

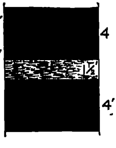


fig 43. p 86

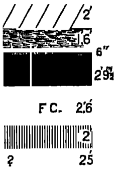


fig 45 p 88

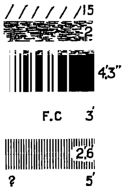


fig. 38. p 83.

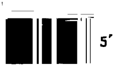
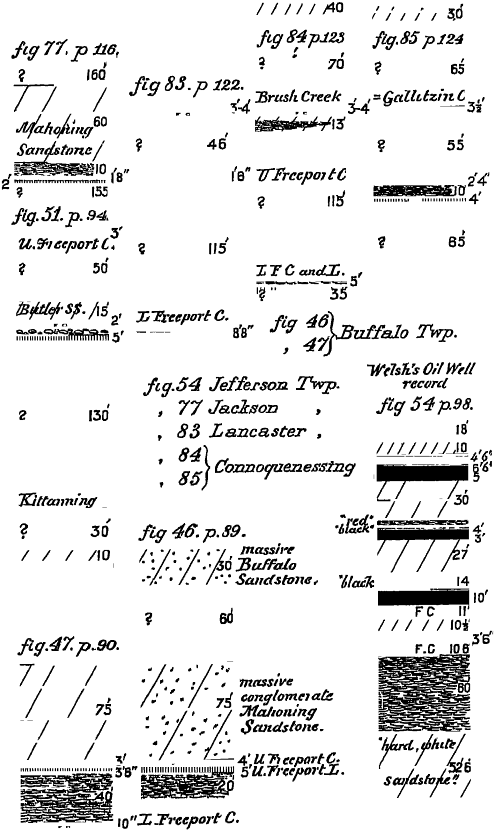


fig. 45 Buffalo Twp.
, 53 Jefferson ,
, 55 Penn ,
, 63 Forward ,
, 64 , , ,

fig 93 Butler Twp.
, 97
, 98 } Summit ,
, 100

Vertical Sections in Butler County.



SECOND GEOL SUR OF PA 1876 REPORT O. PLATE V

Vertical Sections in Butler County.

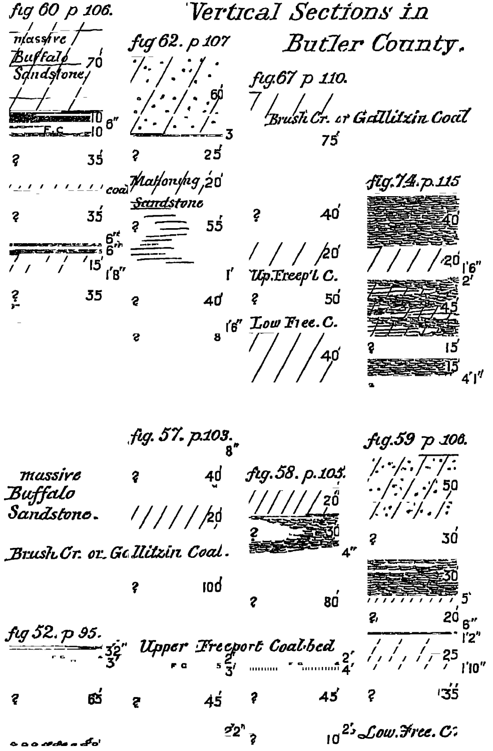


fig. 52. Winfield Twp.
" 57. Penn "
" 58, 59 Forward "

fig. 60, 62, 67 Forward Twp.
" 74 Jackson

Vertical Sections in Butler County.

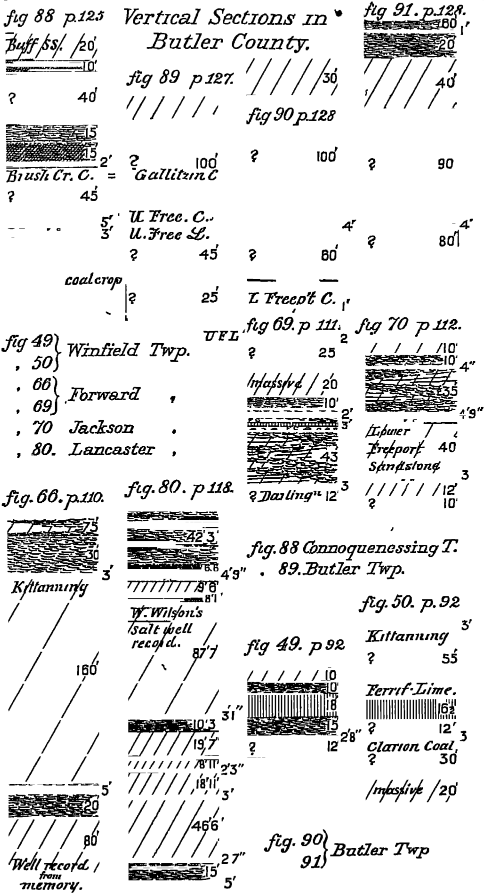


fig 49, 50 Winfield Twp.
" 66, 69 Forward "
" 70 Jackson "
" 80. Lancaster "

fig. 88 Connoquenessing T.
" 89. Butler Twp.

fig. 90, 91 Butler Twp

Lower Freeport Coal in S. Butler Co.

fig 73 p 114

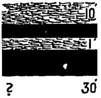
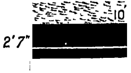


fig 80 p 124



Eichenhauer's Coal Bed

fig. 82. p. 121.

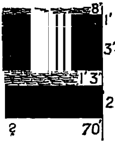
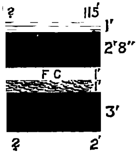


fig. 83. p. 122.



Kearn's Coal-bed

fig. 95 p 132.

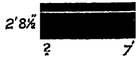


fig 81. p 119

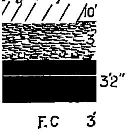


fig. 71. p. 113.

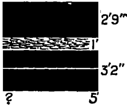


fig. 75. p. 116.

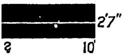
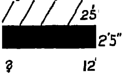


fig. 76. p. 116.



Darlington, or Upper Kittanning Coal.

fig 79. p 118.

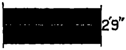


fig 68. p 111.

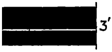
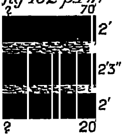


fig 102 p 137.



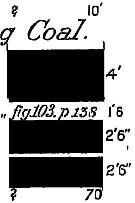
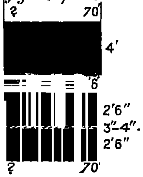


fig103. p 138

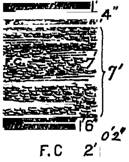
Kittanning Coal-bed.

fig 103. p 138



Lower Homewood Shales.

fig 24. p 70



Vertical Sections in Butler County.

fig 72, 78 } Jackson Twp

92, 94 } Butler

fig 92 p 129

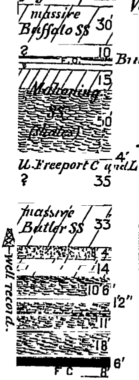


fig. 94 p 131

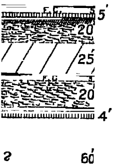


fig 96 p. 133

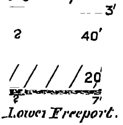


fig. 99. p 135.

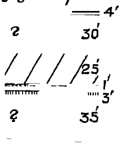


fig. 96, 99 } Summit Twp.

fig 72 p 113.

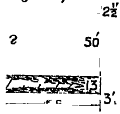


fig 78. p 117

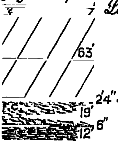


fig 103 p. 138.

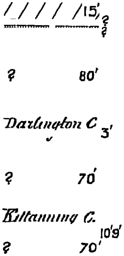


fig. 102 p. 137.

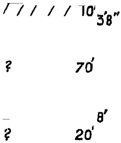


fig. 104 p 139.

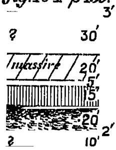


fig. 105. p 139.

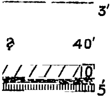


fig. 102, 103, 104, 105 } Clearfield Twp.

SECOND GEOL SUR OF PA 1876 REPORT Q PLATE IX

Vertical Sections in Allegheny County.

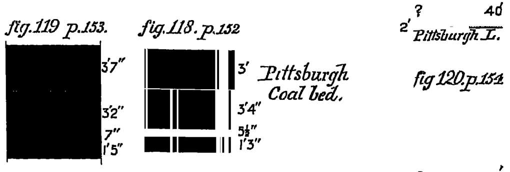
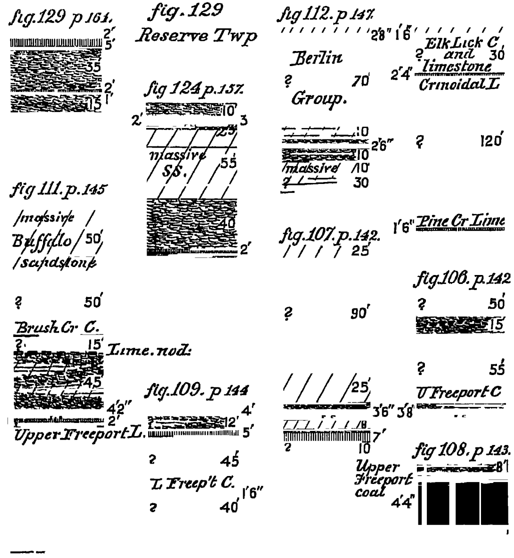


fig. 106, 107, 108, 109, 111 } Fawn Twp.

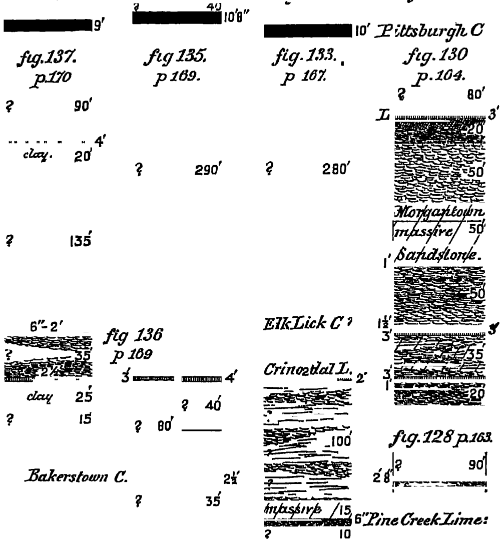
fig. 112 East Deer Twp.

" 118, 119, 120 } Indiana "

" 124 Shaler "



Vertical Sections in Allegheny County



Upper Freeport Coal bed

fig. 113. } East Deer Twp.
, 114. }
, 115. } West Deer ,
, 117. }

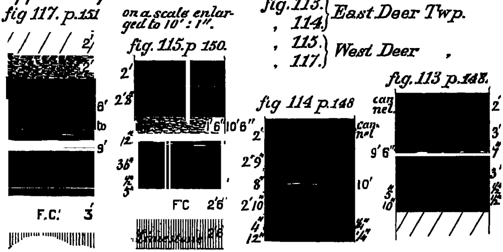


fig. 128. Richland Twp.
, 130. Reserve ,
, 133. Ross ,

fig. 135. } McCandless Twp.
, 136. }
, 137. Pine ,

Vertical Sections in Allegheny County.

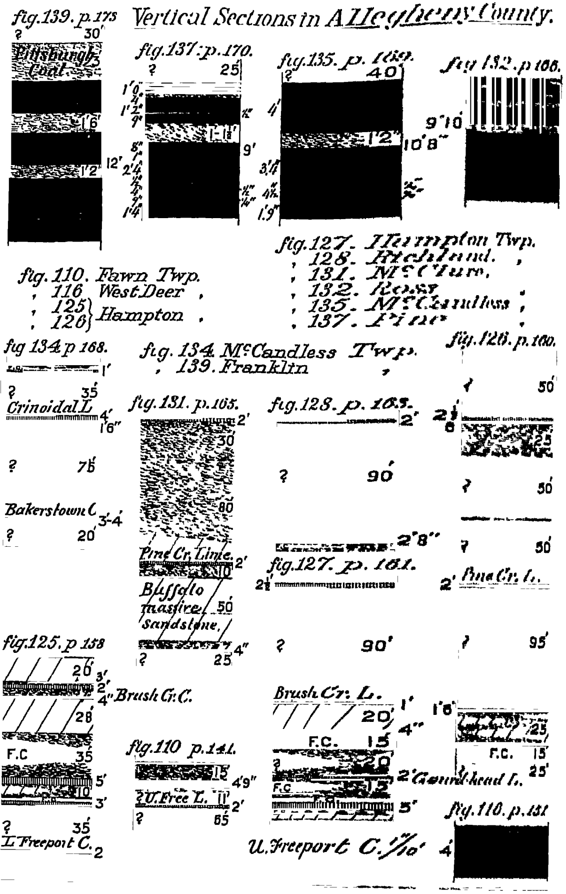


fig. 110. Fawn Twp.
" 116 West Deer "
" 125 } Hampton "
" 126 }

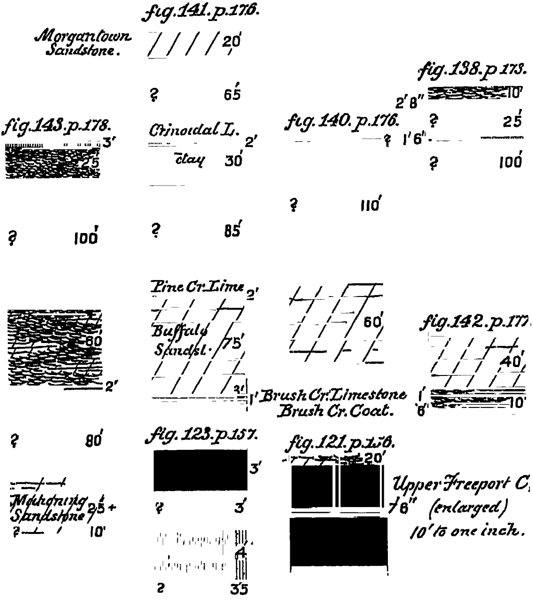
fig. 127. Hampton Twp.
" 128. Richland. "
" 131. McClure. "
" 132. Ross "
" 135. McCandless "
" 137. Pine "

fig. 134 McCandless Twp.
" 139. Franklin "

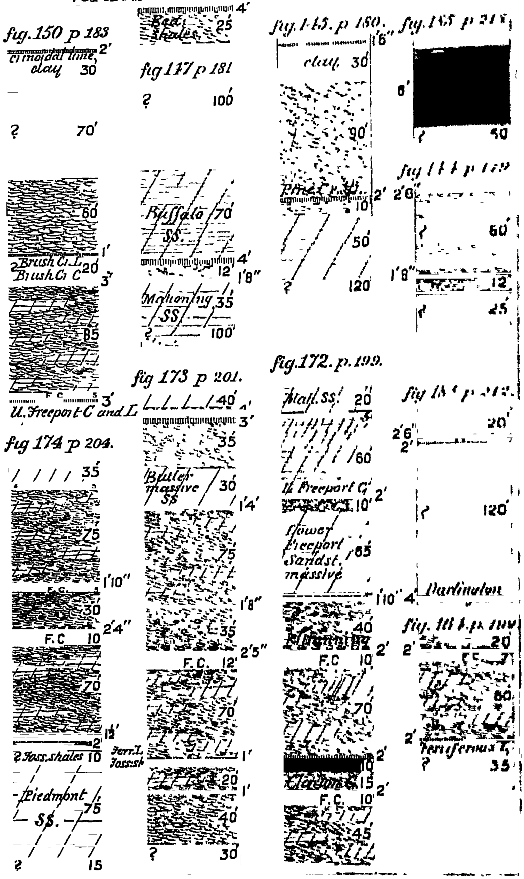
Vertical Sections in Allegheny County.

fig. 121 } Shaler Twp.
123 }
138 Franklin,

fig. 140 } Ohio Twp
141 }
142 } Sewickley,
143 }



Vertical Sections in Beaver County



SECOND GEOL SUR OF PA 1876 REPORT Q PLATE XIV

Vertical Sections in Beaver County.

fig.146 } Economy Twp
 " 149 }
 " 155 } New Sewickley "
 " 156 }
 " 166. Pulaski "

fig.156.p 188.

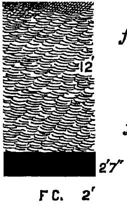


fig.146.p.181.

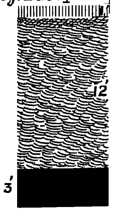
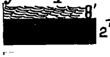


fig.155.p.187.



Brush Cr. Coal (enlarged)

fig.177 }
 " 179 } N. Sewickley Twp.
 " 180 }

fig.214.p.242.

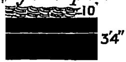
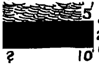


fig 149.p.182.



L. Free. C. (enlarged)

fig.166.p 194

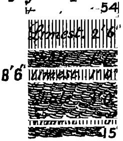


fig.190 Franklin Twp.
 " 214 Beaver "
 " 232 Brighton "

fig.190.p.216.

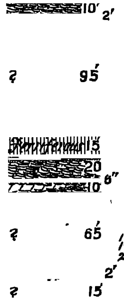
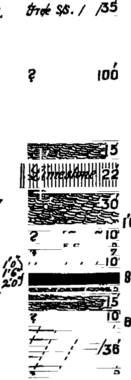


fig.180.p.209.



1'6" Clarion C

8' Brookville C.

fig.177.p.207.

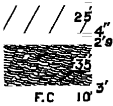


fig179.p 209

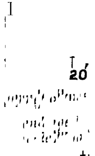


fig 179.p 209.

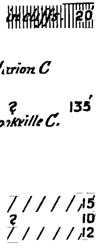
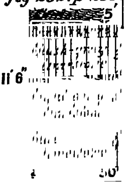


fig 232.p 255.



SECOND GEOL SUR OF PA 1876 REPORT Q PLATE XV.

Vertical Sections in Beaver County.

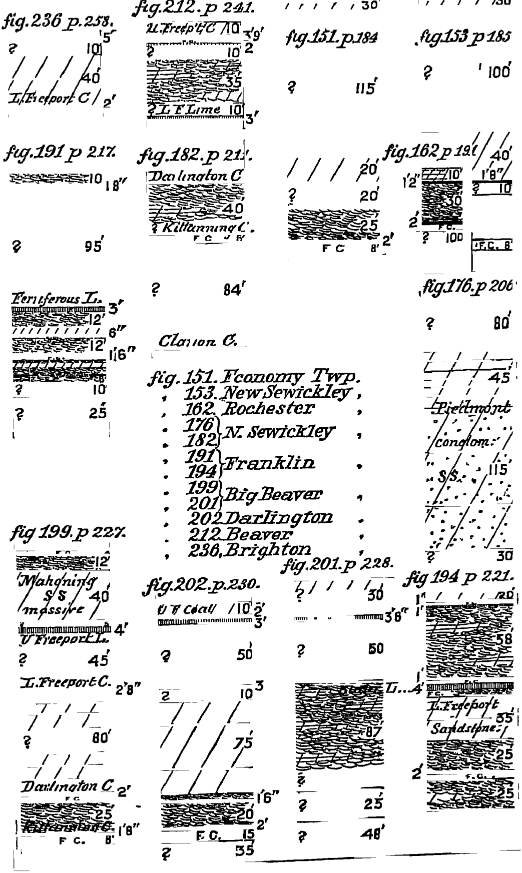


fig. 151. Economy Twp.
, 153. New Sewickley,
, 162. Rochester ,
. 176} N. Sewickley ,
. 182}
, 191} Franklin .
. 194}
. 199} Big Beaver ,
. 201}
, 202 Darlington .
. 212 Beaver ,
, 236. Brighton ,

Vertical Sections in Beaver County.

fig's. 154, 158, 160. in New Sewickley Tp.

fig. 158. p 189.

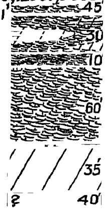


fig. 186 p 213

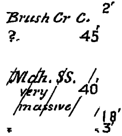


fig 185. p 213.

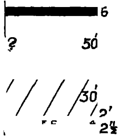


fig. 178. p 208.

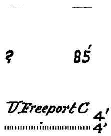


fig. 169 p. 197.

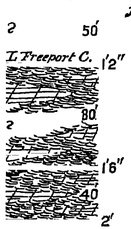


fig 167. p 195.

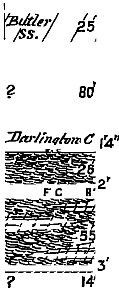


fig. 154. p 186.

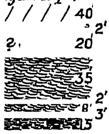


fig. 160 p. 190.

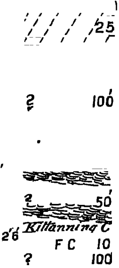
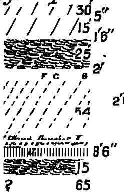


fig. 166 p. 194



fig's. 163, 165 in Rochester Tp.

fig. 166.
167.
168.
169. Pulaski Twp.

178
185
186 N. Sewickley,

fig. 163 p 192.

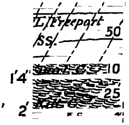


fig. 187. p 214.

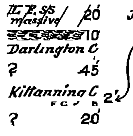


fig. 168. p 196.

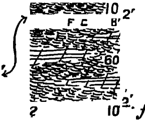


fig. 165. p. 193.

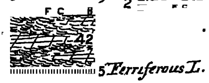


fig. 187. Marion Twp.

Vertical Sections in Beaver County.

Darlington Coal Bed

fig. 181. p 211.

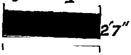


fig. 183 p. 212

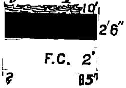


fig 188. p. 215.

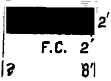


fig 246. p. 266

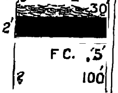


fig. 189. p 216.

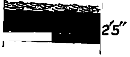


fig. 195. p 222.

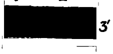


fig. 197. p 225.

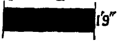
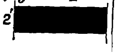


fig. 200. p. 228.



Kittanning Coal Bed.

fig 161. p 191.

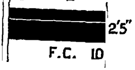


fig 163. p. 192.

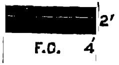


fig. 164. p 192.

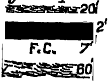


fig 166. p 194.

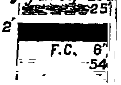


fig. 167 p 195.

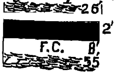


fig. 168. p. 196.

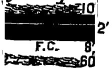


fig. 207. p. 238.

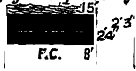


fig. 215. p. 243

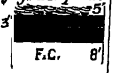


fig. 222. p 247.

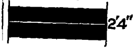


fig. 226. p 251.

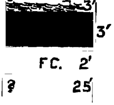


fig. 239. p. 259.

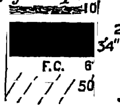


fig. 230. p. 254.

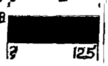


fig. 228. p 252.

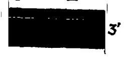
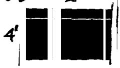
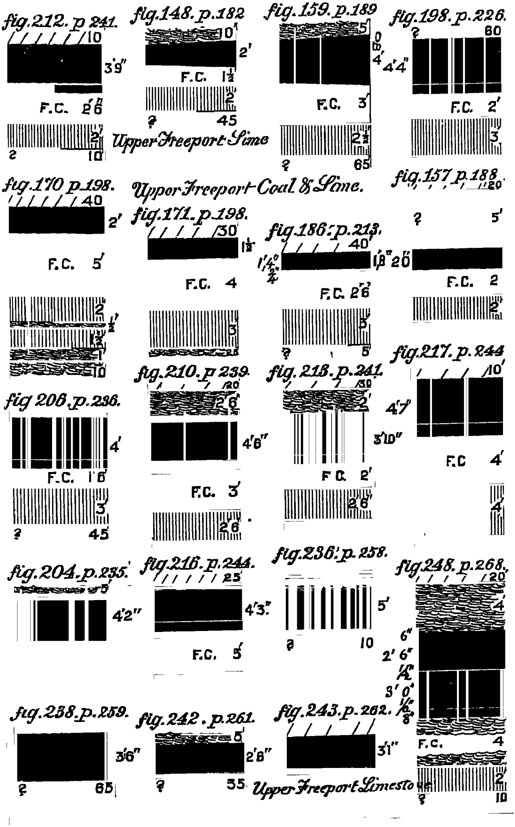


fig. 240. p. 259.



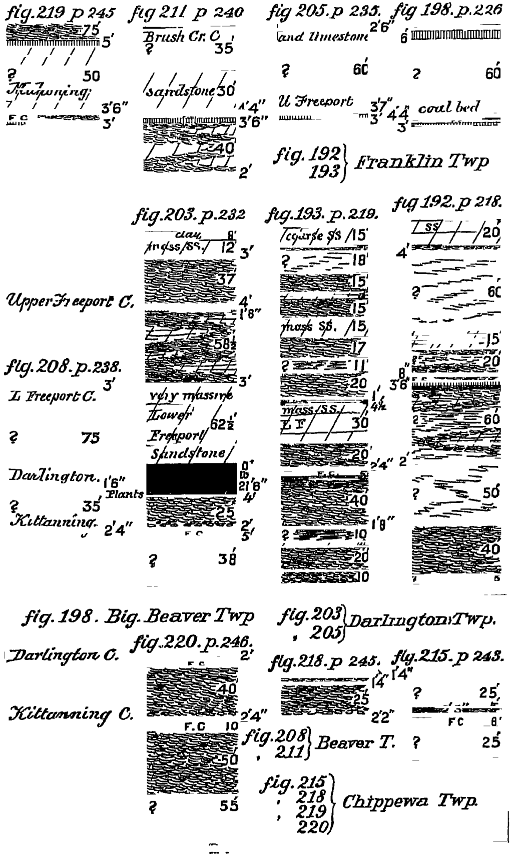
SECOND GEOL SUR OF PA 1876 REPORT Q PLATE XVIII

Vertical Sections in Beaver County.

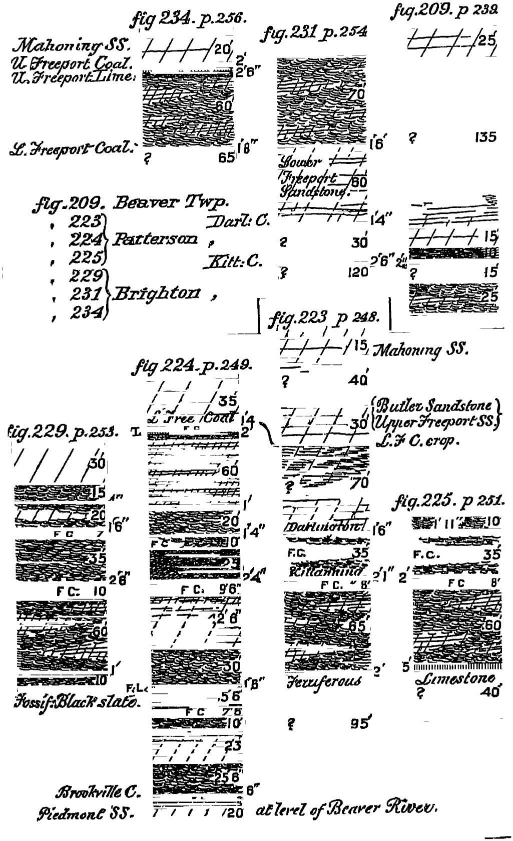


SECOND GEOL SUR OF PA 1876 REPORT Q PLATE XIX

Vertical Sections in Beaver County.



Vertical Sections in Beaver County.



]

Vertical Sections in Beaver County

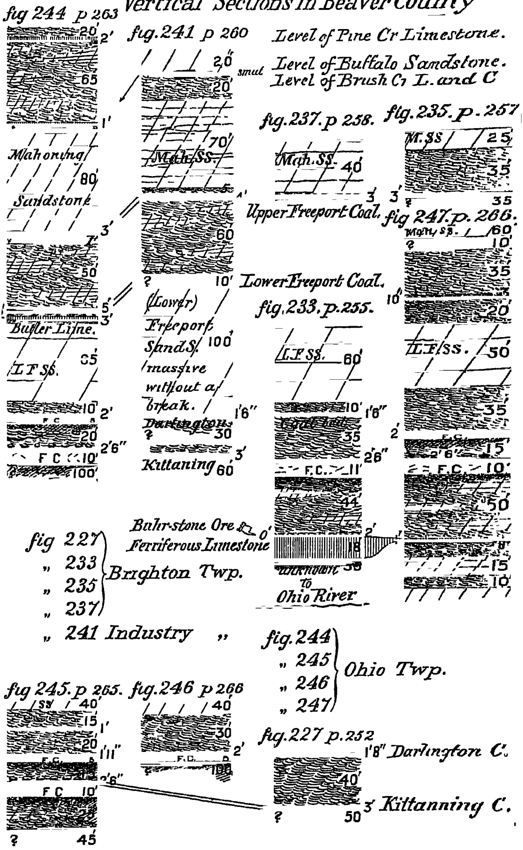


fig 227, „ 233, „ 235, „ 237 } Brighton Twp.

„ 241 Industry „

fig. 244, „ 245, „ 246, „ 247 } Ohio Twp.

Map of
Dry & Island Run
Oil Regions
Beaver Co Pa
To Illustrate Report of Progress Q 1876
By I C White Assist. Geologist.

Scale, about 3300 ft to 1 Inch.